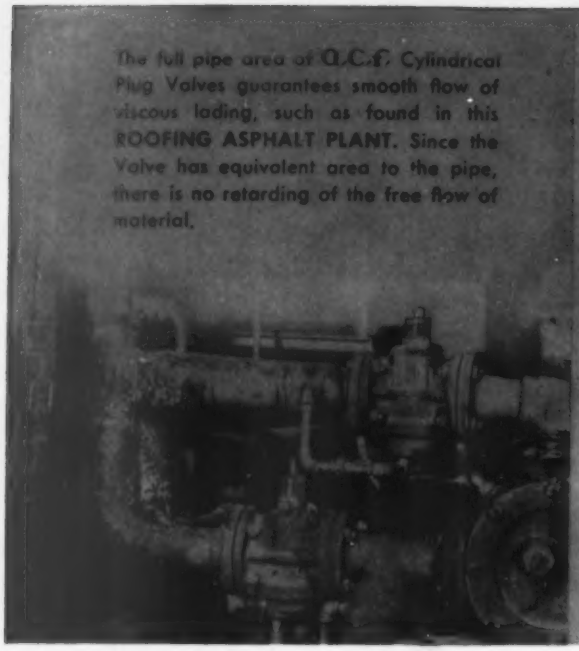
WATER & SEWAGE WORKS

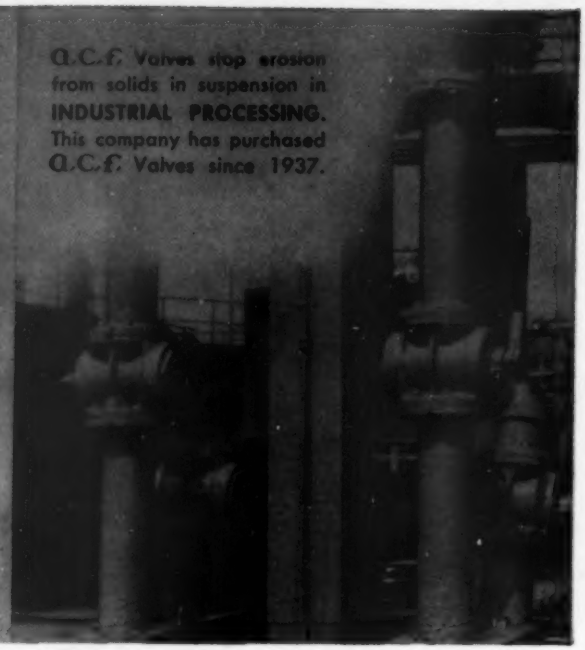
WATER SUPPLY • INDUSTRIAL WASTE TREATMENT • SEWAGE DISPOSAL

JULY 1934

Experimental Trickling Filter at Cyanamid Round Pond

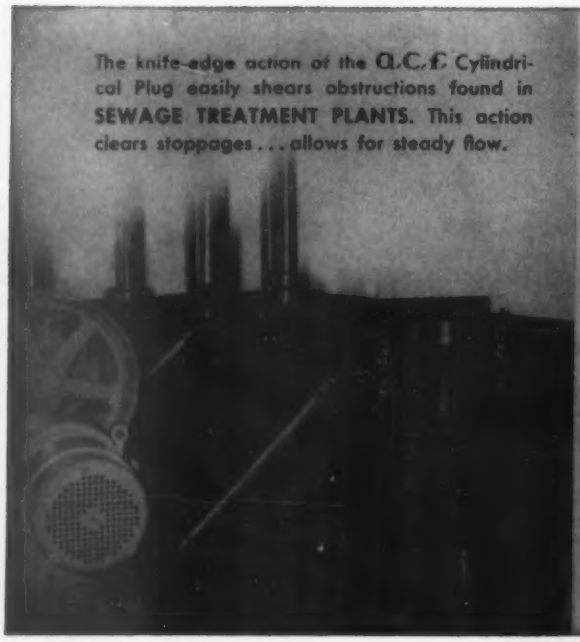


The full pipe area of a.C.f. Cylindrical Plug Valves guarantees smooth flow of viscous lading, such as found in this **ROOFING ASPHALT PLANT.** Since the Valve has equivalent area to the pipe, there is no retarding of the free flow of material.

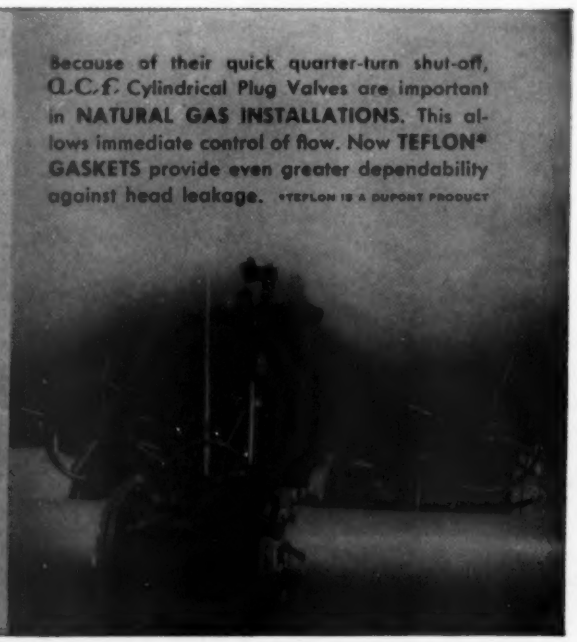


a.C.f. Valves stop erosion from solids in suspension in **INDUSTRIAL PROCESSING.** This company has purchased a.C.f. Valves since 1937.

PROOF OF DEPENDABILITY



The knife-edge action of the a.C.f. Cylindrical Plug easily shears obstructions found in **SEWAGE TREATMENT PLANTS.** This action clears stoppages . . . allows for steady flow.



Because of their quick quarter-turn shut-off, a.C.f. Cylindrical Plug Valves are important in **NATURAL GAS INSTALLATIONS.** This allows immediate control of flow. Now **TEFLON* GASKETS** provide even greater dependability against head leakage. *TEFLON IS A DUPONT PRODUCT

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Photo courtesy City of North Kansas City, Missouri

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- Manganese reduced from 0.2 ppm to essentially zero.
- Turbidity reduced from 50 to only 3 ppm—permits 19 hour per day filter runs with washing only once every 5 days!
- Hardness reduced to level desired.

For full details on the Precipitator write to THE PERMUTIT COMPANY, Dept. W-7, 330 West 42 St., New York 36, N.Y., or to Permutit Company of Canada, Ltd., 6975 Jeanne Mance St., Montreal.

Water Analysis Report Before and After Conditioning

		PPM as	Raw Water from wells before aeration	Precipitator effluent (unfiltered)
CATIONS	Calcium .....(Ca++)	$CaCO_3$	145	55
	Magnesium .....(Mg++)	$CaCO_3$	103	75
	Sodium .....(Na+)	$CaCO_3$	108	105
ANIONS	Bicarbonate (Alkalinity) (HCO_3—)	$CaCO_3$	190	42
	Carbonate (Alkalinity) (CO_3——)	$CaCO_3$	0	24
	Hydroxide (Alkalinity) (OH—)	$CaCO_3$	0	0
	Chloride .....(Cl—)	$CaCO_3$	35	35
	Sulfate .....(SO_4——)	$CaCO_3$	146	139
	Total Hardness.....	$CaCO_3$	248	130
	Alkalinity A (Methyl Orange)	$CaCO_3$	190	66
	Alkalinity B (Phenolphthalein).....	$CaCO_3$	0	12
	Free Carbon Dioxide.....	CO_2	16	0
	IRON (total).....	Fe	5.0	0.1
	Silica.....	SiO_2	16.8	13.0
	MANGANESE	Mn	0.2	0.0
	TURBIDITY (after shaking).....		50	3
	Fluorides.....	F	0.5	0.4
	Color.....		Turbid	5
	pH.....		7.3	9.5
	Total Hardness (as $CaCO_3$).....	Result in grains per U.S. Gal.	15	7.6

WATER CONDITIONING HEADQUARTERS FOR OVER 40 YEARS...

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WATER SUPPLY • SEWAGE DISPOSAL
INDUSTRIAL WASTE TREATMENT

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Centrifugal Pumps—Construction and Maintenance.....*Carter & Karassik*
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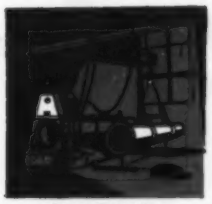

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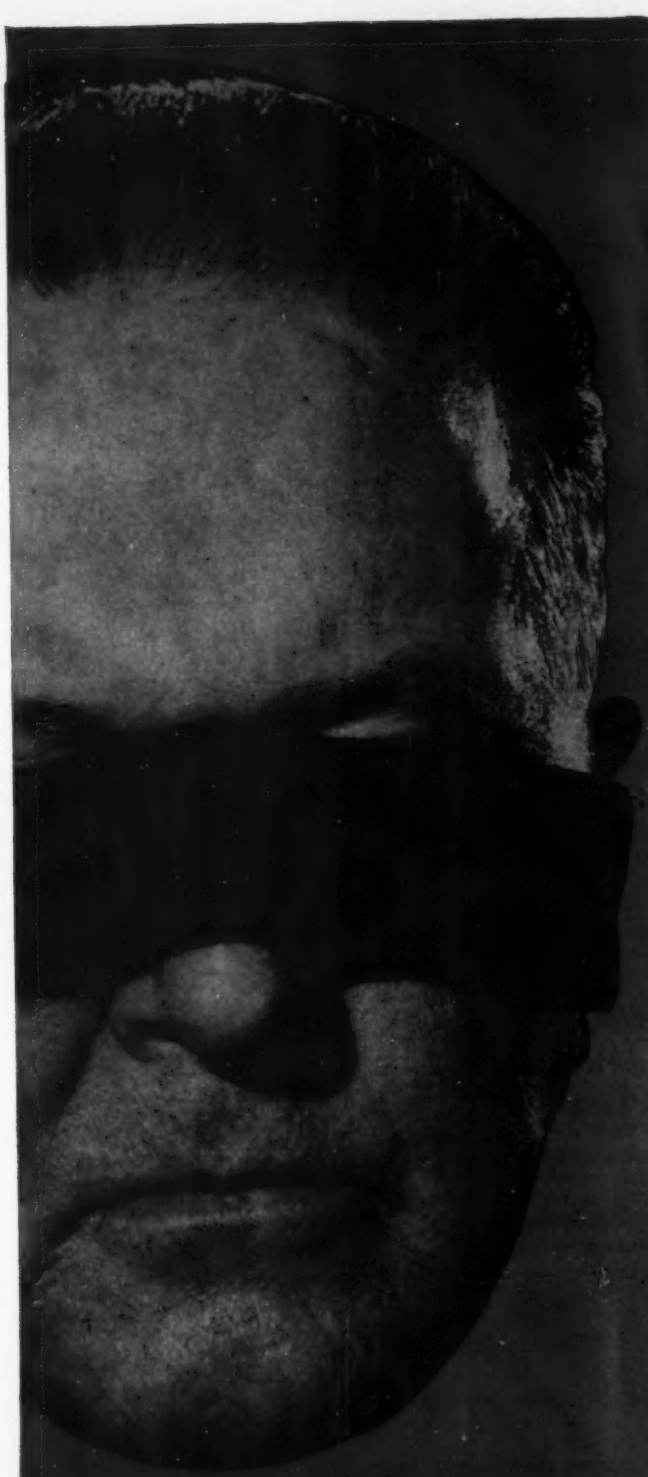

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FACT: cast iron pipe is inherently stronger, tougher, uniform in quality.

FACT: cast iron pipe offers a proven record of low installation and low maintenance costs.

FACT: cast iron pipe's long, trouble-free life saves millions of tax dollars.

FACT: cast iron pipe is the standard conduit for carrying water underground.

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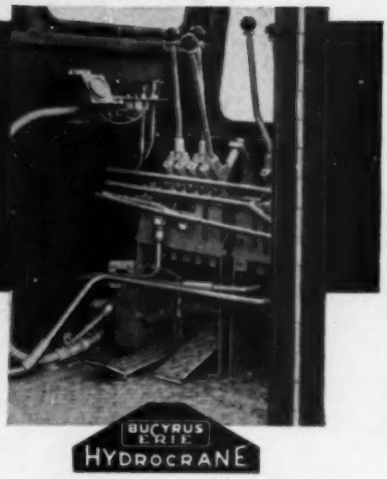

Now Bucyrus-Erie offers a new, more powerful all-hydraulic crane-excavator — the self-powered H-3 Hydrocrane. Taking its power from its own 4-cylinder industrial engine instead of from the truck engine, the new self-powered Hydrocrane provides the following big advantages:

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2. **Selector valve operation.** Power concentration selector unit permits channeling hydraulic fluid from all three pumps to one valve bank — increases line speeds up to 50%.
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5. **Improved efficiency.** Improved oil filtering with less restriction. Better cold weather performance.
6. **Improved truck engine life.** Economy results from fewer truck repair bills. Generator for independent power plant re-charges motor truck battery. Overall fuel consumption is less.

1H54

These are just a few of the advantages of the new self-powered Hydrocrane — and self-power is just one of the big features that is making the Hydrocrane foremost in 1954. See your distributor for complete details.

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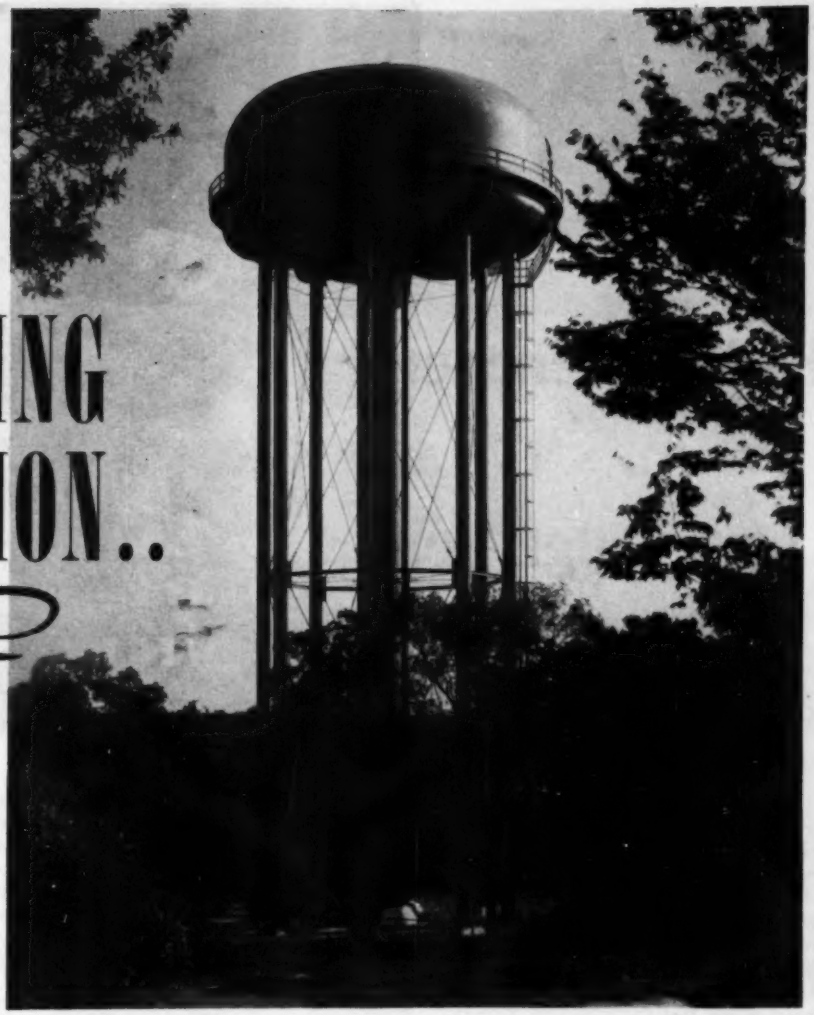

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Shown above is a 500,000-gallon Horton elevated tank recently installed for municipal water service at Aiken, S. C. This new radial-cone bottom tank is one of the latest additions to the growing ranks of Horton elevated tanks that are serving the small communities, villages and cities throughout the nation.

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Detroit 26	1551 Lafayette Bldg.	San Francisco 4	1503—200 Bush St.
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- 200° boom swing

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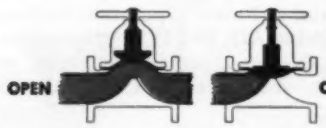
Grinnell-Saunders Diaphragm Valves are available in a range of bodies, linings and diaphragm materials . . . and in a variety of styles and operating mechanisms. If you have a valve problem, it certainly will be well worth your while to consult a Grinnell engineer.



Types of Grinnell-Saunders Diaphragm Valves

Bodies
- Screwed ends — ¼" thru 3"
- Flanged ends — lined or unlined, ½" thru 18"
- Butt weld ends — ½" thru 6"
- Socket ends — ½" thru 4"

Angle Bodies
- Screwed ends — ¼", ⅜", ½", ¾", 1¼", 2"
- Flanged ends — ¾" thru 6".

Bonnets
- Handwheel operated bonnet (available with rising stem, travel stops, extended stem, chainwheel, adapted for Tejax indicator)
- Quick turn — lever operated bonnet, ½" thru 3"
- Bendix-Westinghouse topworks
  - standard (air to close — spring to open)
    - Robotair, ¼" thru 1"
    - Rotochamber, 1" thru 4"; in tandem, 5", 6".
  - direct acting (spring to close — air to open)
    - Robotair, ¼" thru 1"
    - Rotochamber, 1" thru 4"
  - double acting (air to close — air to open)
    - Robotair, ¼" thru 1"
    - Rotochamber, 1" thru 4"
- Piston operated, 6" thru 12"
- Sliding stem bonnet, ½" thru 12"

Diaphragms
- Natural rubber, neoprene, reinforced neoprene for vacuum, hycar, butyl, white gum rubber, Kel-F, Teflon, polyethylene.

Body Materials
- Iron, bronze, stainless steel, cast steel, aluminum, monel, saran, durimet

Body Linings
- Glass, lead, soft rubber, hard rubber, neoprene, saran

Bronze Beer Valves
- Socket both ends
- Socket end to flange end
- Flange both ends
- Socket end to male hose thread end
- Flange end to male hose thread end
- Male hose thread both ends

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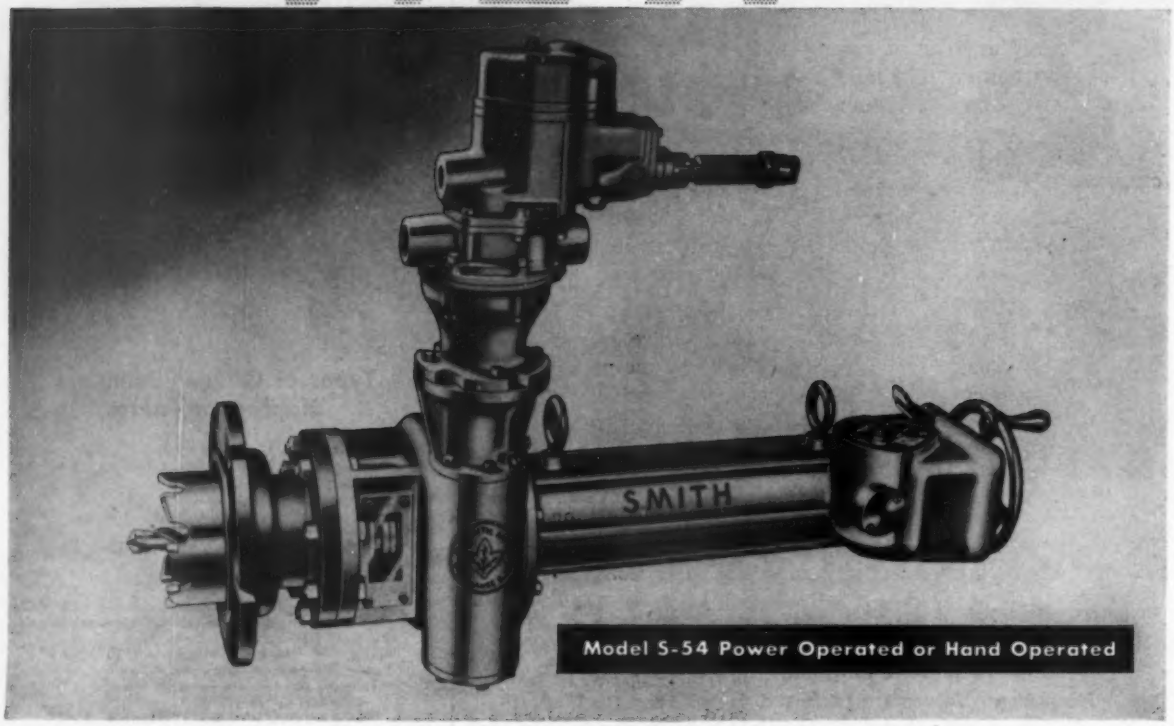
NEW SMITH TAPPING MACHINES FOR TAPS 2″ THRU 12″ INCLUSIVE



The A. P. Smith Mfg. Company in 1896 introduced the first Tapping Machine for making connections sizes 2″ and larger to fluid and gas service piping under pressure. The *NEW* Smith S-54 Tapping Machine is the most modern, efficient and economical machine available. The S-54 Smith Tapping Machine is used with Tapping Sleeves, Hat Flanges, Saddles and Tapping Valves to make 2″ through 12″ connections under pressure to Cast Iron, Cement-Asbestos, Steel and Reinforced Concrete Pressure pipe. 1. AUTOMATIC FEED: Positive automatic feed insures correct drilling and tapping rate. Hand feed is provided to rapidly advance and withdraw Cutter. 2. TRAVEL INDICATOR: Chart attached to machine indicates travel required to complete tap. Travel is *AUTOMATICALLY* terminated when tap is completed. Cutter and shaft cannot overtravel. 3. COMPACT CONSTRUCTION: Telescopic shaft reduces overall length. 25″ travel is adequate for 2″ through 12″ taps to any size of pipe. 4. ENCLOSED CONSTRUCTION: Mechanism is housed in heat treated Aluminum Case filled with lubricant. Foreign matter cannot enter and damage mechanism. 5. STUFFING BOX AND PACKING GLAND: Accessible without disassembling machine. Equipped with Chevron packing. Line pressure cannot enter machine case. 6. RUGGED CONSTRUCTION: Extra large diameter telescopic shaft adds strength and rigidity. Timken radial—thrust bearings maintain alignment, reduce friction and wear. 7. DRIVING GEARS: Worm gearing operates in lubricant, torque is reduced to the minimum. 8. CUTTERS: Have replaceable Flat and Semi-V alternate teeth of High Speed Steel or Tungsten Carbide. 9. FLEXIBILITY: Hand Operated Machines can be converted to Power Operation by interchanging worm gearing. 10. AIR MOTOR: The motor attaches directly to the Power Operated Machine without Brackets, Holders, Adapters or Couplings. Bulletin sent on request.

52

FIRE HYDRANTS · VALVES · SINCE 1896

THE A.P. SMITH MFG. CO.

EAST ORANGE, NEW JERSEY

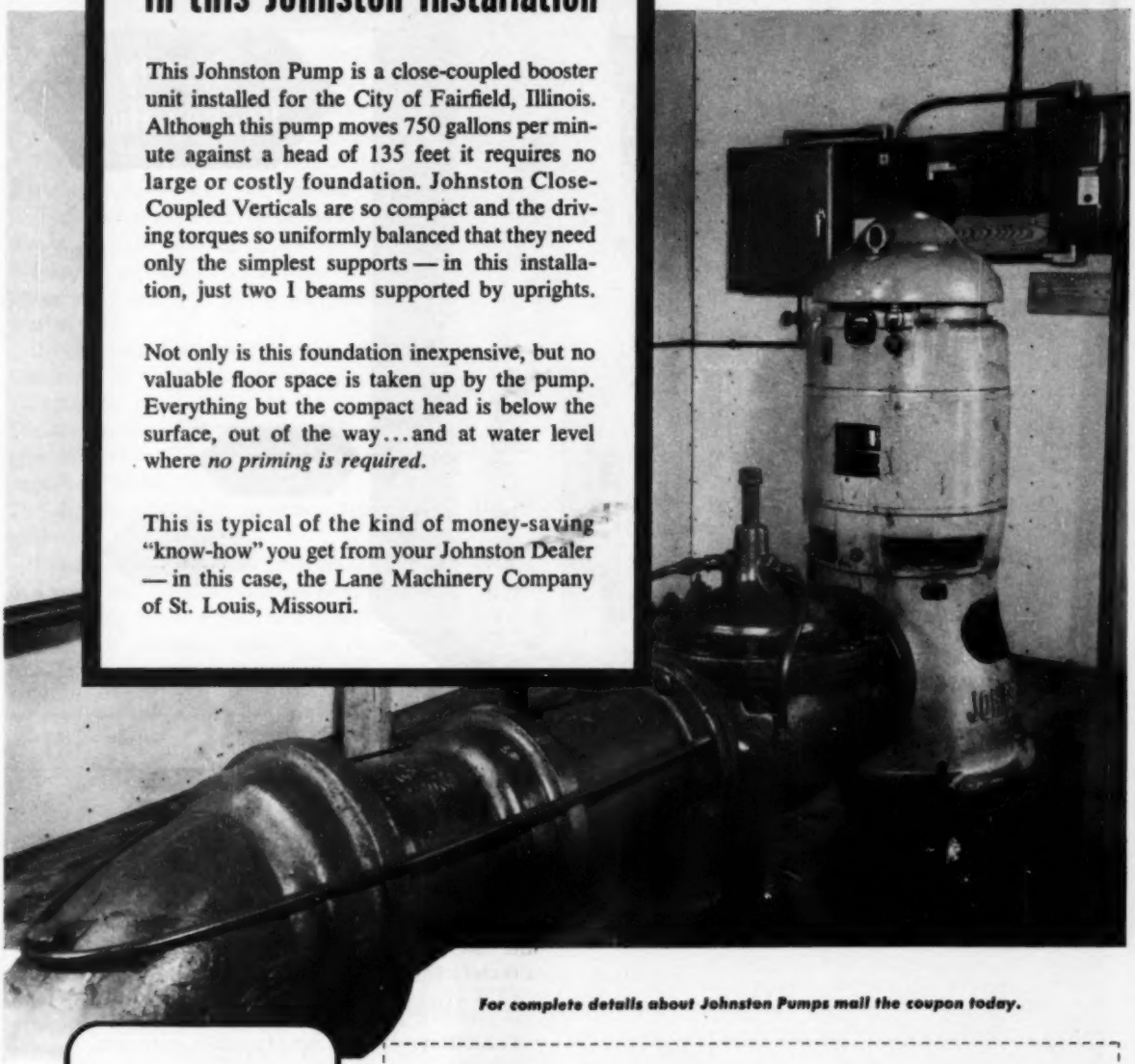
There's a lot of PUMP STORY in this Johnston Installation

This Johnston Pump is a close-coupled booster unit installed for the City of Fairfield, Illinois. Although this pump moves 750 gallons per minute against a head of 135 feet it requires no large or costly foundation. Johnston Close-Coupled Verticals are so compact and the driving torques so uniformly balanced that they need only the simplest supports — in this installation, just two I beams supported by uprights.

Not only is this foundation inexpensive, but no valuable floor space is taken up by the pump. Everything but the compact head is below the surface, out of the way... and at water level where *no priming is required.*

This is typical of the kind of money-saving "know-how" you get from your Johnston Dealer — in this case, the Lane Machinery Company of St. Louis, Missouri.

You can't beat a* JOHNSTON DEALER *for Pump Know-How



For complete details about Johnston Pumps mail the coupon today.

JOHNSTON PUMP COMPANY
Bin "K," Pasadena 19, California

☐ *Please send your Bulletin K-74*

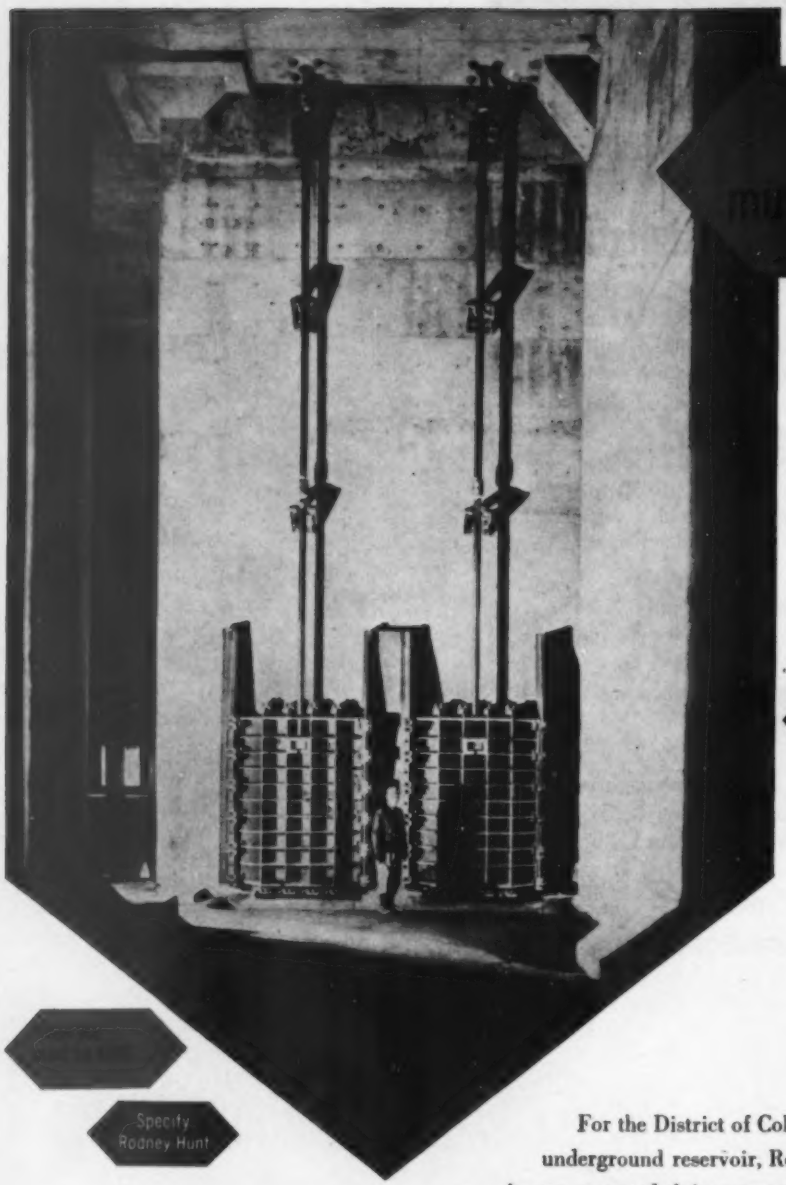
☐ *Have your representative call*

Name _____

Address _____

City _____ **Zone** ____ **State** _____

JOHNSTON
VERTICAL PUMPS



For the District of Columbia's vast underground reservoir, Rodney Hunt cast iron bronze-mounted sluice gates were installed.

Two of the eleven Rodney Hunt gates are shown; the others are as large as 8′ x 8′ clear-opening. All have heavy-duty wedges on all sides, double-bolted top and bottom, to withstand more than 50 feet of unseating pressure.

Specify Rodney Hunt for Sluice Gates and Hoists of superior quality . . . over 2000 combinations of standard types and sizes available . . . and send for our 232-page profusely illustrated catalog. A special 28-page section gives valuable hydraulic engineering data. Write on your letterhead for Catalog WCA 952.

RODNEY HUNT®

Manufacturing Engineers Since 1840

RODNEY HUNT MACHINE CO.

84 Lake Street, Orange, Mass., U.S.A.

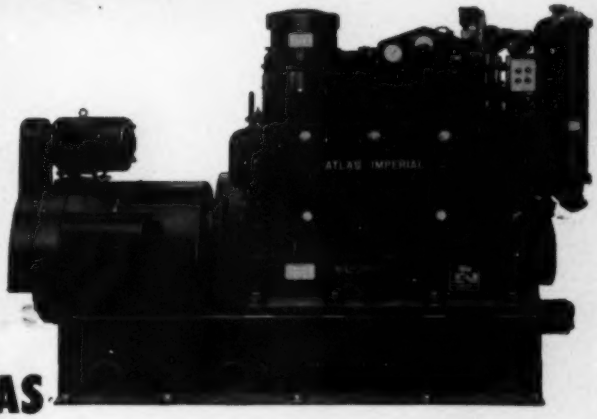
NEED A FUEL-SAVING ELECTRIC PLANT?

Then you'll certainly want all of the facts on the diesel engines that have consistently provided dependable power for generator operation *at the lowest fuel cost per kilowatt hour!*

These famous Superior, Atlas and Lister Diesels are widely used for generator power in municipal light plants, water works, sewage plants . . . for standby power in countless industrial operations . . . and for both propulsion and auxiliary power throughout the marine field.

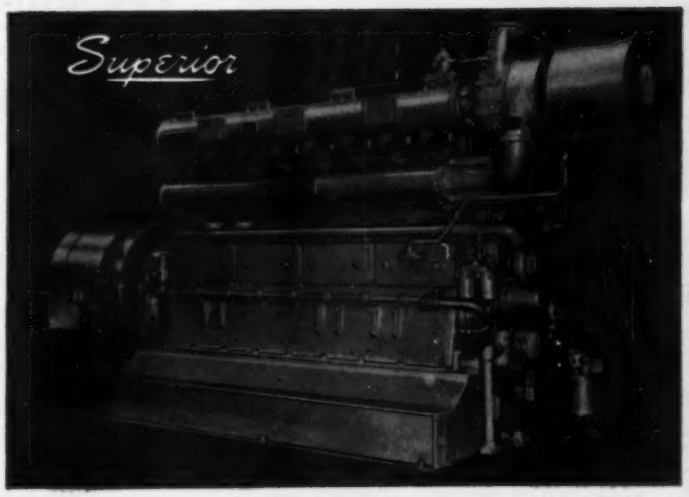
Performance and operating records from hundreds of these installations prove the exceptional economy of National Supply Diesel engines in service. This reputation, plus efficient 4-cycle design and rugged construction, make Superior Atlas or Lister Diesels your best engine investment for power generation.

These National Supply engines are available in a complete range of horsepower ratings to suit virtually every output need (check chart below). For complete information, write or call the nearest sales or service point.



ATLAS

Engine Model	Recommended Generator Capacities
LISTER FR 1	3— 5 KW
LISTER FR 2	10—12 KW
LISTER FR 3	15—18 KW
LISTER FR 4	20—24 KW
LISTER FR 6	30—35 KW
ATLAS Model 35	100 KW to 200 KW
ATLAS Model 45	100 KW to 400 KW
SUPERIOR Model 40	155 KW to 500 KW
SUPERIOR Model 60	280 KW to 645 KW
SUPERIOR Model 65	420 KW to 1250 KW
SUPERIOR Model 80	450 KW to 1000 KW



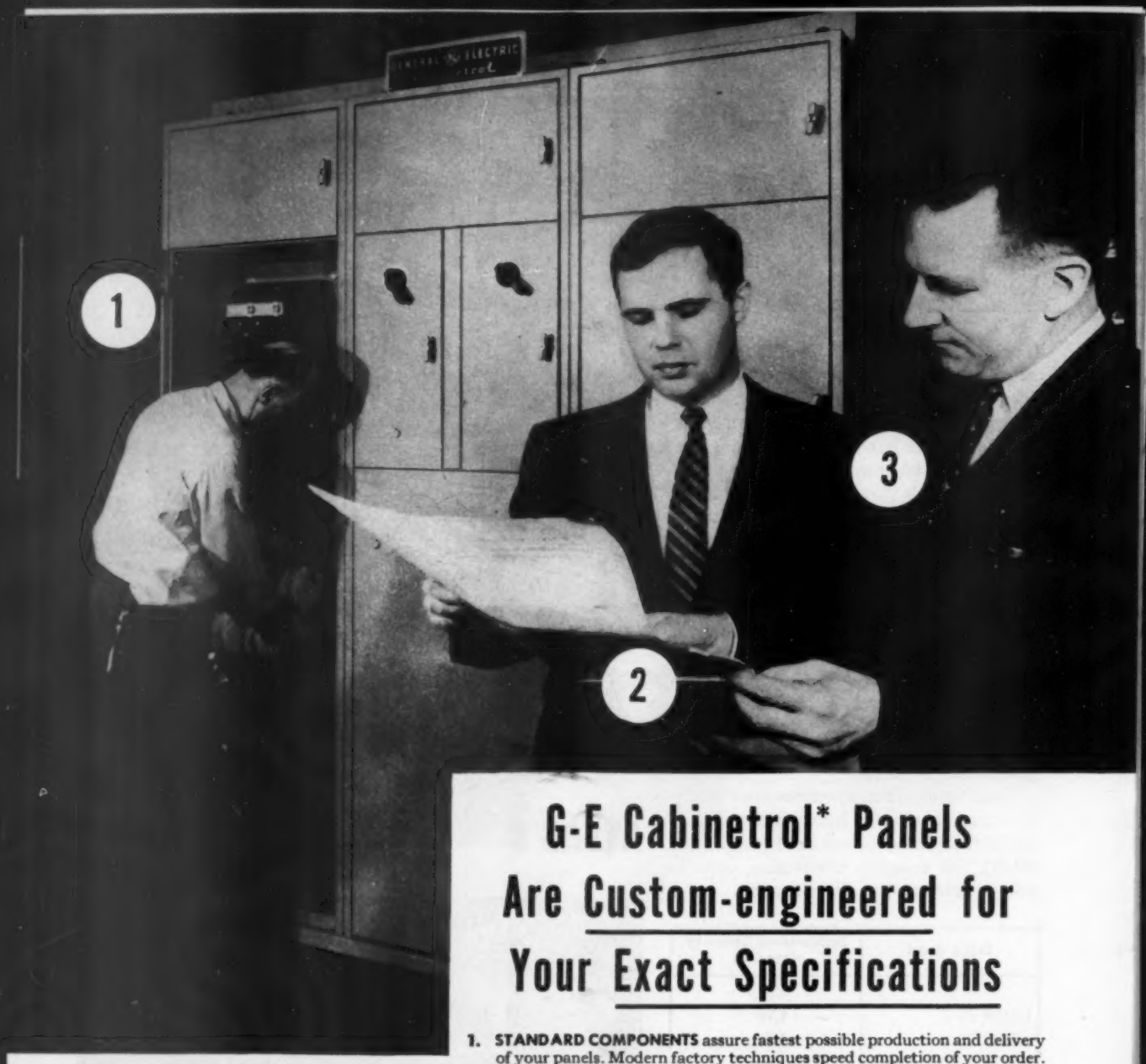
X-4019

DIESEL DUAL FUEL GAS — ATLAS Imperial DIESEL ENGINES — Superior ENGINES — DISTRIBUTOR OF Lister DIESELS IN U.S.A.

THE NATIONAL SUPPLY COMPANY

ENGINE DIVISION PLANT AND GENERAL OFFICES: SPRINGFIELD, OHIO

SALES AND SERVICE POINTS: Gloucester, Massachusetts • Houston, Texas • Fort Worth, Texas • San Diego, California Oakland, California • Terminal Island, California • Ketchikan, Alaska • Washington, D.C. • Chicago, Illinois • Portland, Oregon • Astoria, Oregon • Casper, Wyoming • Halifax, Nova Scotia • Vancouver, B.C. • Toronto, Ontario • Park Rapids, Minnesota • New York, New York • Seattle, Washington • New Orleans, Louisiana • Pittsburgh, Pennsylvania



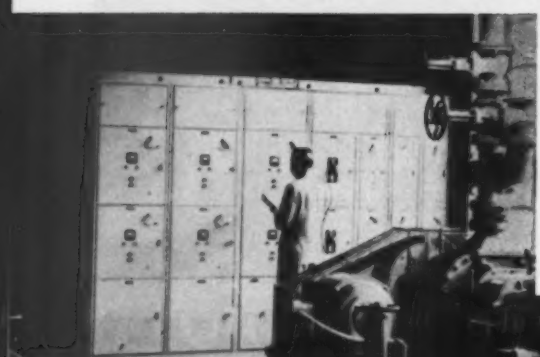
G-E Cabinetrol* Panels Are Custom-engineered for Your Exact Specifications

1. **STANDARD COMPONENTS** assure fastest possible production and delivery of your panels. Modern factory techniques speed completion of your order.
2. **YOUR REQUIREMENTS** are followed exactly. Thorough examination and testing assure "job-tailored" performance.
3. **EXPERIENCED G-E ENGINEERS**—working closely with you—design the unit to meet your application.

Cabinetrol panels are not costly, improvised modifications of some other type of control center. These panels form a **standard** low-voltage control system which handles all motor types up to 600 hp from a central location. You get the time-saving and money-saving advantages of standard components which are custom-assembled.

For complete information, contact your nearest G-E Apparatus Sales representative. Or write for the descriptive bulletin, GEA-3856. Section 780-4, General Electric Company, Schenectady 5, New York.

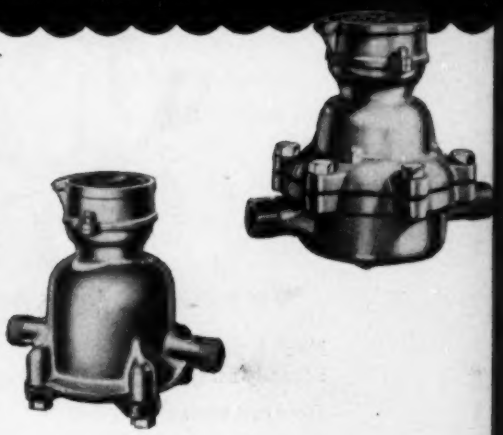
*Reg. trade-mark of General Electric Co.



GENERAL ELECTRIC

Water is vital...

BADGER meters conserve it BETTER!



SANITATION is so vital to life that a city of three-quarters of a million people actually uses 134,000,000 gallons of water daily! In thousands of communities, famous Badger meters make certain that homes and industrial projects get their fair share of the supply . . . pay only for the water they use. Badger meters measure water precisely . . . help eliminate waste . . . make water departments more efficient and self-supporting. And, as waterworks men verify, Badger meters do the job dependably . . . serve for years with little or no attention.

BADGER Water Meters

Badger Meter Mfg. Co.
Milwaukee 45, Wisconsin

"Measures the water of the world"

how much does it cost to run the old model?

Even if you bought new today one of the old model chlorinators, you can actually scrap it right now and save money!

How can such a thing be?

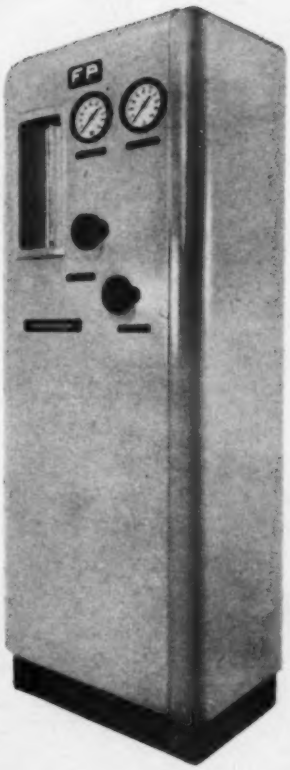
In hundreds of installations using F & P Chlorinators it has been proven conclusively that costs of operation and servicing are so much lower than old style chlorinators that it actually *costs money* right from the first day of operation to have an old style chlorinator.

Fischer & Porter designed this new chlorinator right from the floor up. New materials are used throughout to make it impervious to corrosion. Encased in a fibre-glass cabinet, the new F & P Chlorinator handles chlorine —in fully enclosed, tightly sealed, corrosion resistant pipes and components. It is the best, safest, most efficient, easiest operating chlorinator ever devised.

Right from the purchase price you save money on an F & P Chlorinator. And you save money every day thereafter, because you have less maintenance cost, less chance of breakdown with sky-high service charges, no need for multiple reserve units or scores of spare parts, no wasted chlorine gas lost through water seals.

As a top municipal official, as an ethical consultant, as a practical operating man—you must admit if all these things we say are true, you can't afford to ignore this new chlorinator.

It won't cost you a single penny to *get the facts* about the F & P Chlorinator. It will obligate you in no way. Why not write today?



FP

T.M., F&P CO.

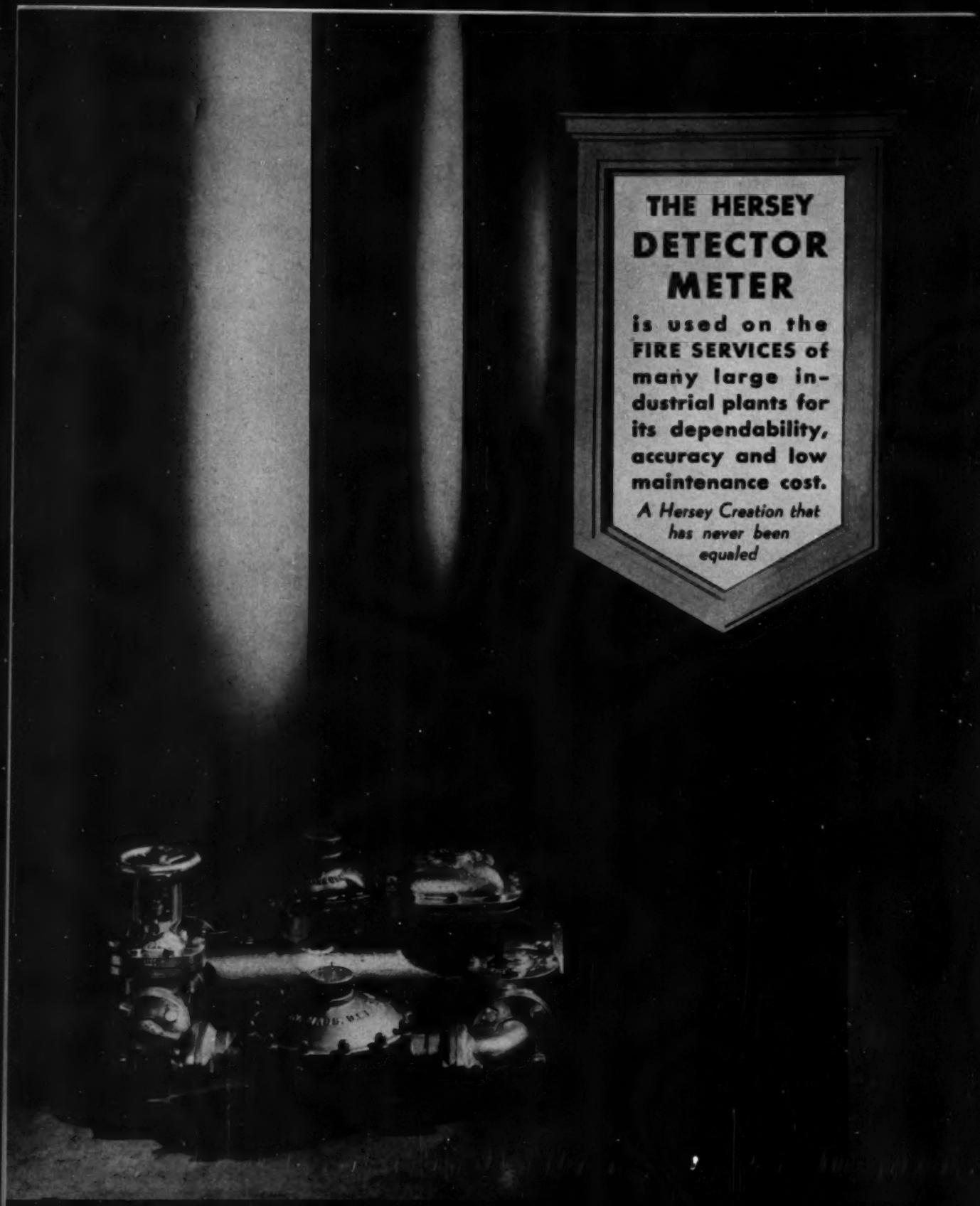
complete process instrumentation

FISCHER & PORTER CO.

503 County Line Road, Hatboro, Pa.

LA-1005

18 YEARS EXPERIENCE SUCCESSFULLY MANUFACTURING CHLORINE FLOW METERING EQUIPMENT

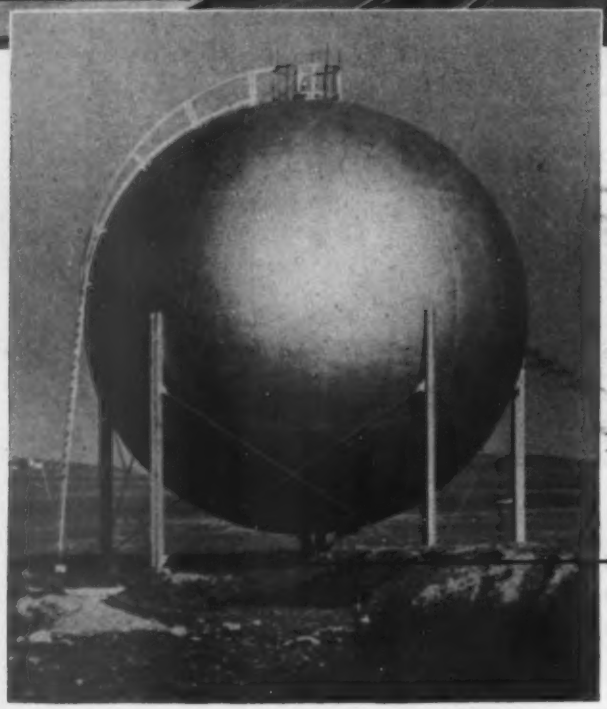

THE HERSEY
DETECTOR
METER
is used on the FIRE SERVICES of many large industrial plants for its dependability, accuracy and low maintenance cost.
A Hersey Creation that has never been equaled

HERSEY MANUFACTURING COMPANY

SOUTH BOSTON, MASS

BRANCH OFFICES: NEW YORK PORTLAND, ORE. PHILADELPHIA ATLANTA DALLAS CHICAGO SAN FRANCISCO LOS ANGELES

For digester gas storage



PITTSBURGH
·DES MOINES

Pressure Spheres

IN DISPOSAL PLANT SERVICE

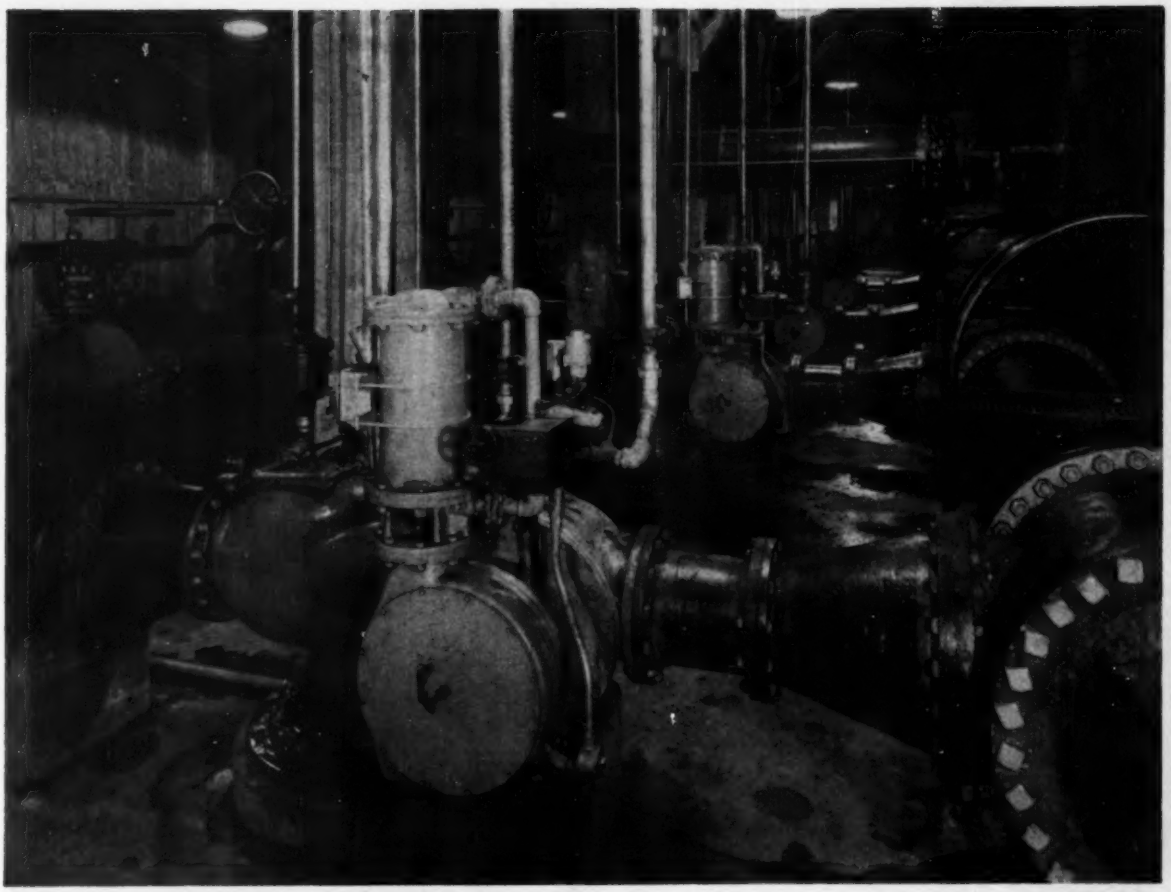
Efficient storage of digester gas in sewage plant operations is provided by Pittsburgh-Des Moines Pressure Spheres. Of unique Icosaphere® design, these modern vessels are more economical to construct, and consequently lower in cost to the purchaser. Let us present the facts and quote on your requirements.

PITTSBURGH • DES MOINES STEEL COMPANY

Plants at PITTSBURGH, DES MOINES and SANTA CLARA

Sales Offices at:

PITTSBURGH (25)	3418 Neville Island	DES MOINES (8)	919 Tuttle Street
NEWARK (2)	218 Industrial Office Bldg.	DALLAS (1)	1223 Praetorian Building
CHICAGO (3)	1222 First National Bank Building	SEATTLE	526 Lane Street
LOS ANGELES (48)	6399 Wilshire Blvd	SANTA CLARA, CAL.	625 Alviso Road



AMERICAN Pipe For Water Filtration Plants

AMERICAN CAST IRON PIPE serves equally well beneath crowded city streets or in water filtration plant installations like the one depicted above. AMERICAN pipe is selected for important installations because of its extraordinary record of permanent dependability.

Manufactured in diameters 2" through 48", this pipe meets nationally recognized standard specifications. The pipe is equipped with any of a wide variety of joints including Flanged, Double-X Mechanical Joint, Screw-Gland, Molox Ball joint River Crossing Pipe, Roll-On joint, or Bell and Spigot.

A complete line of fittings is available including transition pieces for inter-connecting with other types of joints and pipe.

AMERICAN works hand-in-hand with engineers, contractors, and superintendents in solving piping problems in their respective fields. Our unexcelled foundry facilities and highly trained and experienced organization prove exceedingly helpful in connection with pipe installations.

Refer your next piping job to AMERICAN CAST IRON PIPE. Let us assist you by taking off lists of material and submitting prices on pipe and fittings for your next job—preferably when planning begins. Consulting with us will not impose an obligation.

AMERICAN CAST IRON PIPE COMPANY

BIRMINGHAM 2, ALABAMA

MAIL COUPON FOR FREE LITERATURE

American Cast Iron Pipe Company,
Birmingham 2, Alabama

Gentlemen: Please send me a free copy of your literature on flanged pipe and fittings.

Name .....

Company .....

Street .....

City ..... State .....

FOR 100 YEARS

Photo: Ewing Galloway

This is Chicago, second largest city in the U. S. A.—population over 3½ million.

A view of Lake Street, Chicago, as it looked 100 years ago.

Print: Bettmann Archive

MODERNIZED cast iron

they've been coming back for more...

CHICAGO installed cast iron water mains 100 years ago... and installs them today!

Chicago's skyline has changed magically in a century but the underground lines that transport water are still cast iron. Nearly 100% of her water distribution system consists of cast iron pipe. This city of "magnificent distances" has over 4,000 miles (21 million feet) of cast iron mains, supplying more than one billion gallons of water per day to a population approaching four million.

Section of a century-old cast iron main still serving in Chicago's vast water distribution system.

A famous jurist defined *good will* as the "probability of the customer's returning to the old stand." Chicago's Water Department has been coming back for more cast iron pipe for 100 years. That's good will—yes—built on proved performance. Chicago has century-old cast iron pipe in its water distribution system.

Cast iron pipe has been a rugged, long-lived product from the earliest days. Today's *modernized* cast iron pipe, centrifugally cast, is even stronger, tougher, and more uniform in quality. And, where needed and specified, it is centrifugally lined with cement mortar to assure sustained carrying capacity throughout the long life of the pipe.

Cast Iron Pipe Research Association,
Thos. F. Wolfe, Managing Director,
122 So. Michigan Ave., Chicago 3.

CAST Q IRON

The Q-Check stencilled on pipe is the Registered Service Mark of the Cast Iron Pipe Research Association.

pipe FOR MODERN WATER WORKS OPERATION

Compliments not Complaints about the taste of your water!

CITY OF WATERTOWN, NEW YORK
WATER DEPARTMENT
THOMAS B. TYLOSLEY
Superintendent

January 25, 1954

Industrial Chemical Sales Division
West Virginia Pulp & Paper Company
230 Park Avenue
New York 17, New York

Attention: Mr. J. E. Drudy

Gentlemen:

Please accept my thanks and appreciation for your recent immediate response to, and cooperation with our consultants, Malcolm Pirnie Engineers. The work done by Mr. Henry F. Laughlin, your Assistant Director of Research, and Mr. John Foster of Malcolm Pirnie Engineers in determining a treatment to eliminate the bad taste and odor present in our water last October and November gave immediate results.

The recommended treatment of 12 pounds of Aqua Nuchar in slurry form applied directly to the tops of the filters reduced the threshold odor from 16 to 2 with the result that we soon began to receive compliments on our water in place of the flood of complaints that had been customary.

The occurrence of bad taste in our water has been extremely erratic in the past and it may be some time before it develops again but I am sure that your Research Staff has given us a method of treatment that will successfully combat future trouble.

Sincerely yours
Thomas B. Tylosley
Superintendent

TBT/mnl
cc: Malcolm Pirnie Engrs.

● Water treated with AQUA NUCHAR — activated carbon — is more agreeable to the senses of taste and smell. Moreover, the sparkling appearance—(cut diamond effect)—of such water has an enhanced aesthetic value both for the water plant operator *and* for the consumer. AQUA NUCHAR, thus, helps provide water that is palatable to the taste and smell as well as pleasing to the sight.

Threshold Odor Technicians from INDUSTRIAL will be pleased to work with you, *without obligation,* to seek out the most economical means of employing AQUA NUCHAR in your system. These Technicians, *as part of their regular service,* will assist you in the techniques of making the Threshold Odor Test. INDUSTRIAL will run an odor survey of your plant and determine the proper point for application of the carbon. Likewise, a check will be made on the influences of other chemicals used in your process to ascertain the most efficient point of AQUA NUCHAR application.

Contact INDUSTRIAL, now!

industrial CHEMICAL SALES
division west virginia pulp and paper company

Photograph: Mr. John Foster, Malcom Pirnie Engrs. (left), and Mr. Henry F. Laughlin (center), INDUSTRIAL'S Assistant Director of Research, work with Mr. Dale Lawson (right), Watertown, N. Y., Water Department.

Photograph through courtesy of
WATERTOWN DAILY TIMES

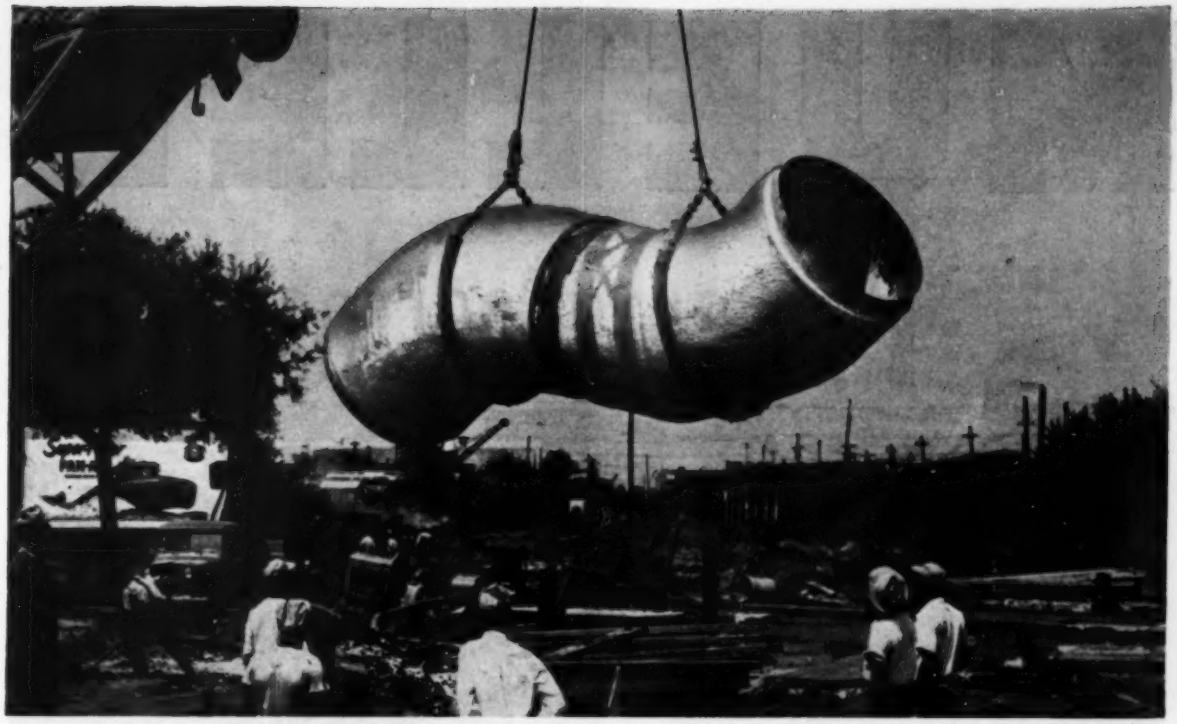
INSURES PALATABLE YOUR NUCHAR DRINKING WATER

New York Central Bldg.
230 Park Ave.
New York 17, N. Y.

Pure Oil Bldg.
35 E. Wacker Dr.
Chicago 1, Ill.

Lincoln-Liberty Bldg.
Broad & Chestnut
Philadelphia 7, Pa.

2775 S. Moreland Blvd.
Cleveland 20, Ohio



Special curved section of 50-in. ID Bethlehem Pipe being lowered into trench in New Orleans.

New Orleans Modernizes Water and Sewerage System with Over 94,000 Feet of Bethlehem Steel Pipe

To meet greatly increased demands caused by the city's tremendous post-war growth, the Water and Sewerage Board of New Orleans has installed almost 18 miles of large-diameter water and sewage lines.

This project began in 1948, when the Board accepted Bethlehem's bid to furnish about 13,500 feet of 50-in. ID tar-enameled steel pipe for the first section of a new feeder line. Today, New Orleans boasts nearly 60,000 feet of new 50-in. ID water mains, as well as 35,000 feet of sewage lines in diameters ranging from 24 in. to 50 in. ID. All of this pipe, together with a variety of T's, bends, reducers and flanges, was supplied by Bethlehem.

You'll find Bethlehem Tar-Enameled Pipe ideal for your water and sewage lines. It has great strength, shock-resistance and resilience. And its smooth, uniform lining of coal-tar enamel resists corrosion and incrustation, ensures a high rate of flow year after year. It is furnished in easily-handled 40-ft lengths, and in all diameters from 22 in. ID to the largest permitted by common carriers.

We suggest that you phone or write the nearest Bethlehem sales office for complete information about Bethlehem Tar-Enameled Steel Pipe.

Laying straight section of 50-in. ID pipe. Engineers on the job found the Bethlehem Pipe easy to cut and re-weld when obstructions were encountered.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation
Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM *Tar-Enameled* STEEL PIPE

MUELLER®

Prevents corrosion!

use this Corporation Stop with Insulating Coupling Outlet!

Designed for a specific need, this Corporation Stop with Insulating Coupling Outlet minimizes electrolytic action and subsequent corrosion by completely insulating copper service lines from the main.

The Insulating Outlet Corporation Stop is easily installed in the main, under pressure, with the Mueller "B" Machine. Copper service pipe is flared with standard tools to prevent pull-out. Coupling needs only minimum tightening for a perfect seal.

Contact your Mueller Representative or write direct for details.

MUELLER CO.

Dependable Since 1857

MAIN OFFICE & FACTORY DECATUR, ILLINOIS

CRACKER BARREL

...CIRCA '54

Your radio becomes a listening post at the crossroads of the world . . . every week . . . when Fairbanks-Morse, in cooperation with the editors of *Nation's Business*, brings you an authoritative roundup of the news events most important to everyone's business.

Today, more than ever before, it is to your advantage to keep informed . . . and here is a factual summary presented in a form which better enables you to make the judgments necessary to your business. Be sure you tune in *this week* to the "Nation's Business." See the table at the right for local station and time. Fairbanks, Morse & Co., 600 South Michigan Ave., Chicago 5, Illinois.

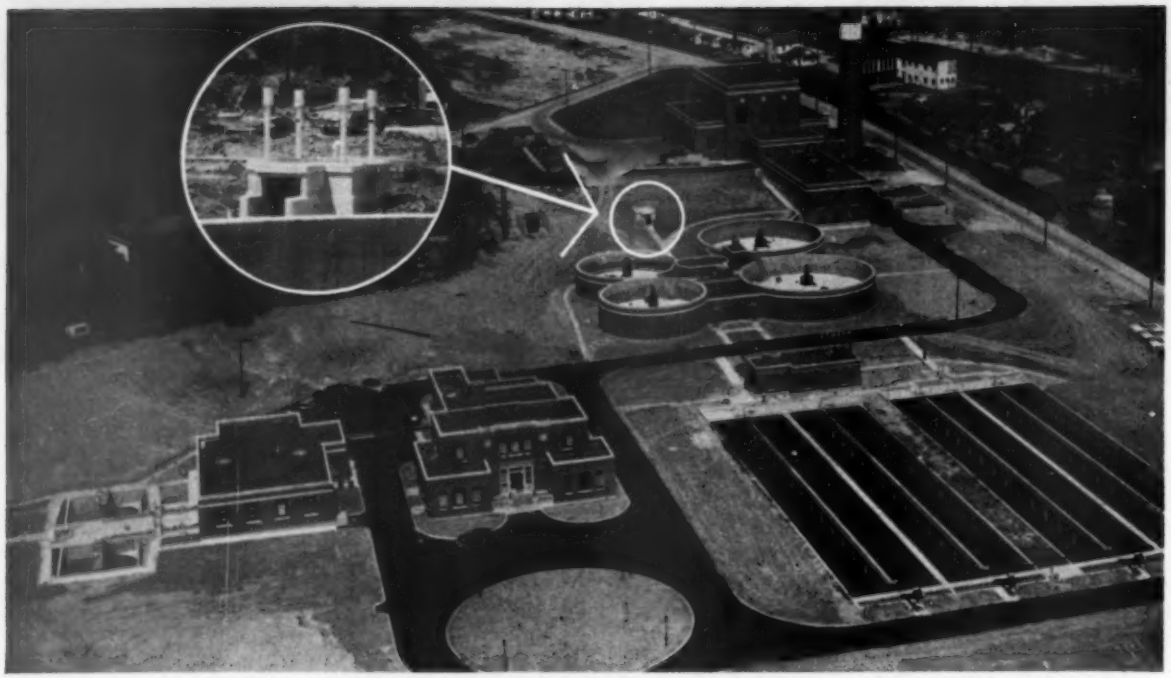
Tune in this week

City	Station	P.M. Time and Day
Atlanta, Ga.	WSB	7:15 Mon.
Baltimore, Md.	WBAL	7:15 Mon.
Beloit, Wis.	WGEZ	7:45 Mon.
Birmingham, Ala.	WBRC	6:15 Mon.
Boston, Mass.	WBZ	8:00 Tues.
Buffalo, N. Y.	WBEN	7:00 Mon.
Charlotte, N. C.	WBT	7:30 Mon.
Chicago, Ill.	WGN	8:05 Mon.
Cincinnati, Ohio	WLW	7:00 Mon.
Cleveland, Ohio	WGAR	7:30 Mon.
Columbus, Ohio	WHKC	6:45 Mon.
Dallas, Texas	KRLD	6:30 Mon.
Davenport, Iowa	WOC	6:15 Mon.
Denver, Colo.	KOA	8:30 Mon.
Des Moines, Iowa	WHO	7:15 Tues.
Detroit, Mich.	WWJ	6:45 Mon.
Duluth, Minn.	WDSM	8:15 Mon.
Freeport, Ill.	WFRL	4:15 Mon.
Houston, Tex.	KXYZ	7:00 Tues.
Indianapolis, Ind.	WFBM	6:15 Mon.
Jacksonville, Fla.	WJAX	7:15 Mon.
Kansas City, Mo.	WDAF	6:15 Mon.
Knoxville, Tenn.	WNOX	6:30 Tues.
Los Angeles, Calif.	KFI	7:45 Mon.
Louisville, Ky.	WHAS	6:30 Mon.
Memphis, Tenn.	WMPS	6:30 Mon.
Milwaukee, Wis.	WCAN	7:15 Mon.
New Orleans, La.	WWL	6:30 Mon.
New York, N. Y.	WOR	9:05 Tues.
Omaha, Nebr.	KFAB	6:30 Mon.
Philadelphia, Pa.	WCAU	7:30 Mon.
Pittsburgh, Pa.	KDKA	6:30 Tues.
Pomona, Calif.	KPMO	6:15 Mon.
Portland, Oregon	KGW	6:45 Mon.
Providence, R. I.	WPRO	6:29 Mon.
St. Johnsbury, Vt.	WTWN	7:15 Mon.
St. Louis, Mo.	KSD	7:15 Tues.
St. Paul, Minn.	KSTP	6:15 Mon.
Salt Lake City, Utah	KSL	7:30 Tues.
San Francisco, Calif.	KCBS	7:00 Mon.
Seattle, Wash.	KOMO	6:45 Mon.
Stuttgart, Ark.	KWAK	6:30 Mon.
Tulsa, Okla.	KVOO	6:45 Mon.
Washington, D. C.	WMAL	8:15 Mon.
Overseas	WRUL	6:30 Mon.

FAIRBANKS-MORSE

a name worth remembering when you want the best

DIESEL AND DUAL FUEL ENGINES • DIESEL LOCOMOTIVES • RAIL CARS
ELECTRICAL MACHINERY • PUMPS • SCALES • HOME WATER SERVICE
EQUIPMENT • FARM MACHINERY • MAGNETOS



At Arlington County, Virginia . . .

capacity increased—operations simplified

WITH P.F.T. FLOATING COVERS

In 1953, fast growing Arlington County expanded its capacity in a *practical* way by:

(1) converting its two 50′ tanks to secondary digestors
(2) adding two 65′ tanks for primary digestion
(3) equipping all four with P.F.T. Floating Covers

The result: P.F.T. "Controlled Digestion" and a new capacity of 20,000,000 gallons per day— 4 times the capacity of its former design!

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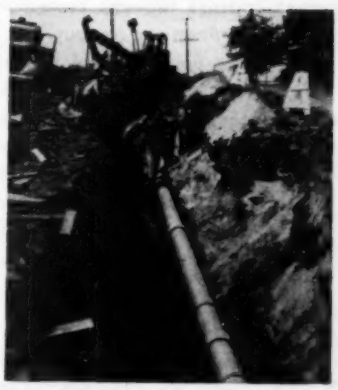

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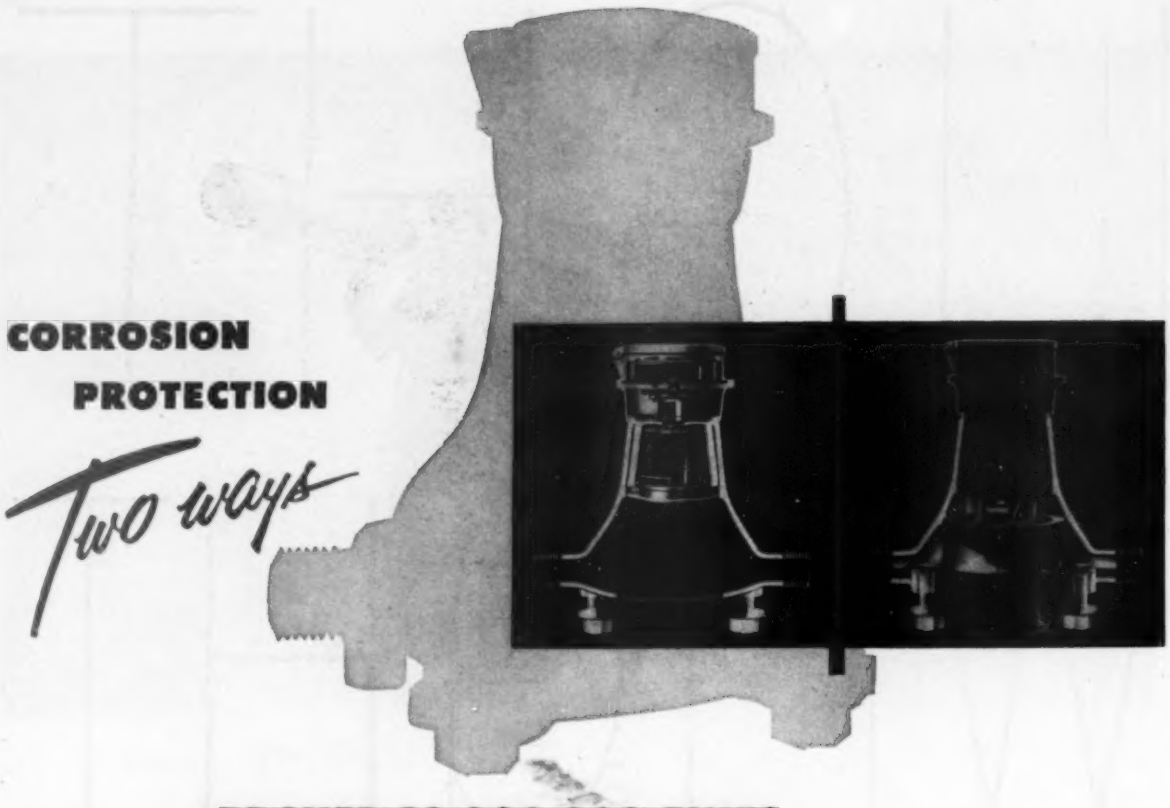

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WATER & SEWAGE WORKS

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DETERIORATION of well screens—some plugged, some enlarged—is illustrated by this photo

Our Wells Resist Cleaning!

Two engineers report on the failure of chemicals to clean deep wells at Lake Charles, La.

by **E. CLARENCE ODEN,** *Chief Process Engr., and* **CHARLES E. SMITH, JR.,** *Process Engr.*
Cities Service Refining Corp., Lake Charles, La.

WITH the comparatively recent industrial development in the Lake Charles area, it was realized that the availability of fresh ground water would become a problem. Although ground water investigations were begun in Louisiana in 1938, through the co-operation of the U. S. Department of Interior and the Louisiana Department of Conservation, it was not until 1943 that investigations were begun in the Lake Charles area. During the year 1943, the program was expanded to include the Louisiana Department of Public Works.

There are three principal aquifers in the Lake Charles area, referred to as the "200-foot" sand, the "500-foot" sand and the "700-foot" sand. Screened wells located in these sands in the Lake Charles industrial area are illustrated in Fig. 1.

Although the "200-foot" sand probably is the principal domestic aquifer in this area, some industrial wells also tap this sand. It yields a good quality of water at a relatively low temperature (about 69° F). This sand, which usually is about 100 feet in thickness, also supplies a large portion of the water used for irrigation of rice land in the area.

Ground Water Supplies

Undoubtedly the best and most widely used of the three water-bearing sands is the "500-foot' sand, which is from 150 to 250 feet in thickness. Industrial wells, such as those in service at the Lake Charles Refinery of the Cities Service Refining Corp., and at the Government-owned Butadiene Plant operated by the Cities Service Refining Corp., usually are large diameter wells; that is, wells having 6 to 12-inch diameter screens and 16 to 34-inch diameter pump pits or casings. These wells yield up to 2,000 gpm of good quality water, the temperature of which is about 74° F.

In addition to the industries drawing from this sand, the many large rice land irrigation wells now screened in this sand apparently have a great effect on the water table in the area. This is especially evident during the summer months, as can be seen from Fig. 3, a plot of trends of static levels taken on the "500-foot" well, Cu-445, located north of the basic refinery and east of the Butadiene Plant. It has been pointed out by Jones' that wells too closely spaced will cause mutual interference. Such interference, between two wells

screened in the same sand, will vary directly with the rates of pumping and approximately with the logarithm of the reciprocal of the distance between the wells.

The "700-foot" sand, approximately 100 feet in thickness throughout the area, definitely yields a poorer quality of water than that from the "500-foot" sand—as can be seen from the analyses of water samples from both sands, Table 1. Industrial plants in this area and the city of Lake Charles are supplied from wells in the "700-foot" sand, producing up to 2,000 gpm at a temperature of about 77° F.

Comparative analyses of water samples taken from the three sands, Table 1, show that the chemical composition of the water from the "200-foot" sand and "500-foot" sand has remained relatively constant, but the "700-foot" water analyses show marked change in chemical composition. The high chloride content is an indication of possible salt water contamination of this sand.

Original Well System

The Lake Charles Refinery of the Cities Service Refining Corp., as a part of its original facilities, had three wells, Cu-93, 94, and 95, all of which were screened in the "500-foot" sand. Two of these were equipped with 150 hp electric motors and one with a 150 hp steam turbine, each driving a three-stage pump, set 120 feet below land surface and rated at 1,500 gpm. Due to the fact that these wells were installed during World War II when materials were scarce, the screens consisted of approximately 110 feet of 10-inch slotted carbon steel pipe. A cross section of these original wells, including measurements, is presented in Fig. 4. These wells were connected to a 10-inch main header which supplied all well water requirements for the refinery: boiler feed water, drinking and sanitary water, process water, etc. Originally no cooling tower make-up water was required; when first placed in operation, the refinery had only a once-through cooling water system utilizing water from the Calcasieu River.

In 1945, approximately two years later, another well was installed at the sulfuric acid plant to supply water for cooling furnace gas by direct contact. The well also was screened in the "500-foot" sand, and was rated at 1,500 gpm. Again a 150 hp electric motor was used to drive a three-stage pump set 180 feet below land surface. Unlike the other three wells, this well had a screen of 100 feet of 10-inch perforated carbon steel pipe wrapped with galvanized wire.

The Government-owned Butadiene Plant, adjacent to the refinery, had in its original installation three wells (Cu-96, 97, and 98) equipped with 150 hp electric motors, driving three-stage pumps rated at 1,500 gpm each. One of these wells was screened in the "500-foot" sand and two in the "700-foot" sand. Here again the screens were of the 10-inch slotted carbon steel type. In October, 1946, another well (Cu-461) screened in the "500-foot" sand was put into service. It was equipped with a 250 hp electric motor driving a five-stage pump rated at 1,500 gpm. The well screen was a 10-inch perforated carbon steel pipe wrapped with stainless steel wire.

Present Well Facilities

Each year since 1948, the static levels of the original wells have dropped from 5-15 feet as shown in Fig. 3. Increased drawdowns indicated the poor condition of the screens or the sand to be responsible. It was realized that unless something was done to alleviate the situation the supply of fresh ground water would become critical. As the need arose to lower pumps, steps were taken to clean the screens and surrounding sand, to increase the number of pump stages, to increase driver horsepower, and finally to pull the original screens, rework the wells and install stainless steel shutter type screens (Fig. 2) in each of the original refinery wells.

At the present time, four of the original wells have been reworked, and one new well (Cu-560) was installed at the treating plant in 1951. The new well is equipped with a six-stage submersible pump set at 280 feet below ground surface, and equipped with a 200 hp motor. It is screened in the "500-foot" sand. Water from this well is discharged into two lines: one line runs to the acid plant to supplement water from the acid plant well (Cu-454), and the other line runs through gasoline coolers at the treating plant and to the power house for boiler feed water.

Table 1

WATER FROM 200-FOOT SAND

Analyses from Lake Charles Refinery of Continental Oil Co.

Parts per million	1943	1944	1945	1946	1947	1948	1949	1950
Turbidity as SiO_2	None	None	Trace	Trace	Trace	Trace	Trace	Trace
Suspended Matter	None	None	None	None	None	None	None	None
Color	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Sulfate (SO_4)	8	12	4	16	32	32	2	10
Chloride (Cl)	25	28	27	29	35	26	31	29
Iron (Fe)	None	None	None	None	None	None	None	None
Silica (SiO_2)	28	22	17	26	26	30	17	26
Free CO_2, Calc.	30	33	....	....	....	....	....	....
Total Hardness as $CaCO_3$	106	124	120	108	106	84	122	73
Phenolphthalein Alkalinity as $CaCO_3$	0	0	0	0	0	0	0	0
Methyl Orange Alkalinity as $CaCO_3$	192	208	194	218	196	210	196	206
pH	7.1	7.1	7.5	7.5	7.3	8.1	7.5	7.5

WATER FROM WELL CU-94 IN 500-FOOT SAND

	Jan. 20, 1949	Nov. 28, 1950	June 8, 1951	Nov. 5, 1952
Silica (SiO_2)	18	35	35	25
Iron (Fe)	2	1	1.3	0.9
Calcium (Ca)	48	39	.....	.....
Magnesium (Mg)	15	15	.....	.....
Sodium (Na)	34	29	.....	38
Potassium (K)	3	3	.....	.....
Aluminum (Al)	9	9	.....	.....
Chloride (Cl)	20	23	21	20
Sylfate (SO_4)	14	11	5	4
Hardness as $Ca(HCO_3)_2$	101	93	.....	.....
Total Hardness as $CaCO_3$	181	154	131	158
Total Dissolved Solids	264	258	270	256
Phenolphthalein Alkalinity	.....	.....	0	0
Methyl Orange Alkalinity	.....	.....	180	176
Ammonia	.....	.....	<1	<1
pH	7.3	7.4	7.5	7.5

WATER FROM WELL CU-98 IN 700-FOOT SAND

Analyses by U. S. Dept. of Int., Geological Survey, Baton Rouge, La.

	June 26, 1945	August 25, 1948	July 18, 1950
Silica (SiO_2)	46	.....	58
Iron (Fe)	0.0	2.5	1.1
Calcium (Ca)	.....	.....	51
Magnesium (Mg)	.....	.....	16
Sodium (Na)	.....	.....	190
Potassium (K)	.....	.....	2.0
Carbonate (CO_3)	.....	.....	0.0
Bicarbonate (HCO_3)	173	196	202
Sulfate (SO_4)	4	.....	1.9
Chloride (Cl)	105	191	306
Fluoride (F)	.....	0.1	0.1
Nitrate (NO_3)	.....	.....	0.0
Boron (B)	.....	.....	0.21
CO_2, Calc.	.....	.....	1.6
Total Hardness as $CaCO_3$	97	155	193
Total Dissolved Solids	390	.....	740
Specific Conductance ($K \times 10^6$ at 25° C)	.....	931	1,300
pH	7.3	8.2	8.3

Data on motor horsepower, number of pump stages, and pump settings below ground surface for the reworked wells are given below:

Well	Motor H.P.	No. of Pump Stages	Setting in Ft. Below Ground
Cu-93	250	4	270
Cu-94	250	4	280
Cu-95	250	5	242
Cu-454	250	5	280

After completion of the present refinery expansion program, two additional wells will be put into service. These will furnish make-up water to two new cooling towers and will be screened in the "500-foot" sand. Both of these wells will be connected to the main well water system to assure adequate make-up water in the event of a temporary well failure.

The Butadiene Plant also has undergone changes in its well water system. The bulk of the well water requirements for this plant now is supplied by two new "500-foot" wells which are equipped with 300 hp submersible motors and pumps and with 12-inch stainless steel shutter type screens. One old "500-foot" well is on stand-by status for use during times of a low water table. Another new "500-foot" well will be drilled in the near future to assure an adequate well water supply at all times. Eventually, all four of the old wells (two "500-foot" and two "700-foot") will be removed from service by plugging or capping. This project already has been started by plugging one "700-foot" well up to the "500-foot" sand with concrete and capping.

Cleaning Screens and Sand

In order to fully describe the results of cleaning screens and sand, the procedure followed for each well will be reviewed. Methods used at the Butadiene Plant are also included to report all methods investigated. It should be pointed out that this discussion covers the period prior to reworking of wells.

Well Cu-93

Since 1948 the pump in well Cu-93 was lowered from 120 to 160 feet below ground level, and the well was acidized three times during 1950.

The well was first acidized on February 2, 1950, by applying 4,000 gallons of 15 per cent inhibited hydrochloric acid. The acid was injected through the suction pipe and pump, and enough water was added to force the acid down through the screen and into the surrounding sand. After a 30-minute reaction period, the acid was pumped out.

The second acidization on February 10, 1950, was carried out exactly as before except that reaction time was increased from the previous 30 minutes to 3 hours and 15 minutes.

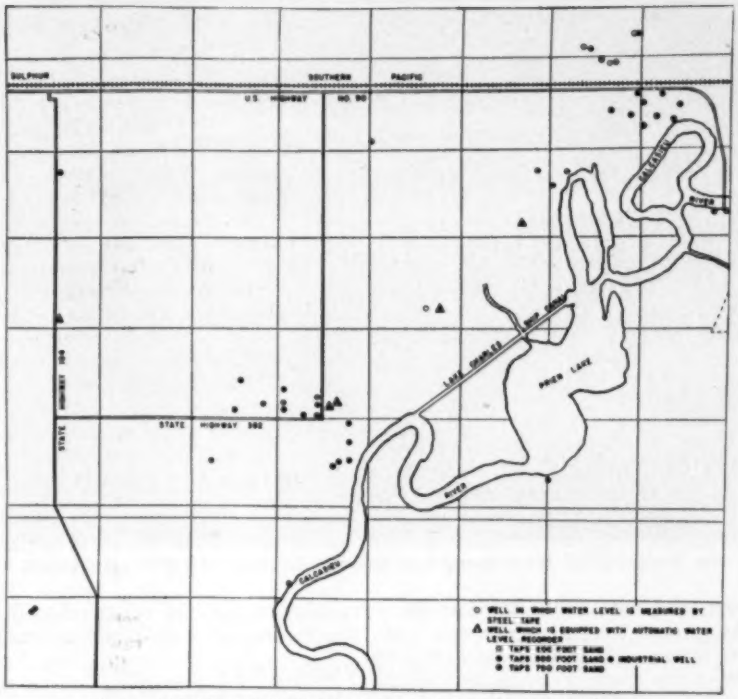


Fig. 1—OBSERVATION WELLS in the Lake Charles industrial area
Principal aquifers are at 200, 500 and 700-foot levels

The third and last acidization was done on March 28, 1950, by a slightly different method. The acid (4,000 gallons of 15 per cent inhibited hydrochloric acid) was injected down a 2-inch line through a swab which distributed the acid over 20-foot sections of screen at a time. The swab was made up of a 2-inch perforated pipe having 7-inch, 9-inch, 10-inch, 9-inch, and 7-inch diameter rubber gaskets sandwiched together in that order on each end of the pipe. This pyramidal effect was used to ensure rigidity at the pipe and flexibility at the circumference. The gaskets were held together on each end of the pipe by metal plates welded to the pipe on each side of the two groups of gaskets. The two groups of gaskets were spaced approximately four feet apart. A proper distribution of acid over the entire length of the screen was insured by the use of this swab, and also a more concentrated solution reached the screen and the sand. The acid was allowed to stand in the well for 18 hours before being pumped out; thus, the reaction time was considerably longer than both of the previous acidizations combined.

Test data were recorded before and after acidizations. Since this well is not equipped with flow indicating or recording instruments, no accurate measurement of flow was obtained. Pumping levels and drawdowns were improved by as much as 25 feet when comparing those recorded before acidizations and after the third acidization. Spot checks made approximately one year after acidizations (April, 1951) indicated that this well was still in relatively good condition, though the static level was about 5 feet lower than a year previously.

Well Cu-94

Of the four wells in operation at the refinery, Well Cu-94 probably had remained in the best condition. The lack of a flow recorder on this well, and the fact that the pump speed is manually controlled by adjustment of steam flow to the turbine driver, prevented the accumulation of sufficient data for drawdown calculations. Since the turbine speed could be controlled, this well was and is still pumped to distribute the load between the three wells supplying the main header; i.e., to keep the pumped water level in balance.

The only change in this well was the lowering of the pump from 120 to 140 feet below ground level. No attempt was made to chemically clean this well since it has been in operation.

Well Cu-95

Well Cu-95, in service since 1943, was equipped with a three-stage

Fig. 2—STAINLESS STEEL shutter-type screens which replaced carbon steel screens

pump originally set at 120 feet below the ground level. A continually falling water table made it necessary to lower the pump in order to prevent loss of suction. In September, 1948, the pump was lowered 20 feet; in August, 1949, it was lowered an additional 20 feet to a final depth below the ground level of 160 feet.

In July, 1949, a method of cleaning the screen by using compressed air was applied. The compressed air (at about 200 psig) was injected down through a line and discharged through a swab which operated over a 20-foot section of screen at a time, in an effort to loosen incrustations on the screen. During the swabbing and blowing process, a hole either was blown in the screen or the swab tore the screen at a depth of about 428 feet. After this damage occurred, the compressed air method of cleaning was abandoned and acid cleaning was substituted. Before acidization it was necessary to install a 7-inch filler screen in the original 10-inch screen; the filler screen was similar to the 7-inch screen installation in well Cu-454 at the Acid Plant.

After the motor, suction pipe, and pump had been replaced a dose of 2,000 gallons of 15 per cent inhibited hydrochloric acid was injected down through the suction pipe and pump. The acid application was followed by approximately 3,000 gallons of water, injected to displace the acid down through the screen.

Due to the installation of the 7-inch filler screen and to the lack of a flow recorder at this well, no good comparison of data could be made. However, there were indications that the pumping level had dropped approximately 10 feet at comparable discharge pressures and motor currents.

Well Cu-454

Well Cu-454, which supplies the Acid Plant, was put into service in 1945. Approximately one year later a 7-inch filler screen was inserted in the 10-inch screen because of sanding.

Since this well has been in operation, two methods of chemically cleaning the screen and the sand have been attempted. These were the injection of Calgon (sodium hexametaphosphate) followed by calcium hypochlorite, and the injection of inhibited hydrochloric acid.

The first method of cleaning tried was the use of Calgon. In the original treatment, on November 22, 1949, 1,300 pounds of Calgon in solution, followed by 50 pounds of calcium hypochlorite in solution, were injected. The solutions were applied through a ¾-inch line, entering by means of a hole in the base plate of the well. This treatment was accomplished without removing the motor, suction pipe, or pump. The chemicals were added at the top of the casing, and a sufficient quantity of water was added to force the chemicals down to the screen. Due to the low solubility of Calgon, water was flowed continually over the chemical in the feed drum in order to dissolve it.

After the Calgon was displaced by water, the well was surged 12 times each 4 hours over a 48-hour period, and then was pumped out. Since the first treatment apparently was unsuccessful, possibly due to improper concentration of the chemical at the screen, a second Calgon treatment was attempted. Fig. 5, a plot of drawdown versus flow, bears out the fact that this first treatment did no good.

For the second treatment on December 22, 1949, a dose of 2,100 pounds of Calgon at a concentration of 300 pounds per barrel of solution was injected through a ¾-inch line down to a depth of 420 feet. The 420-foot level was 15 feet above the perforations in the screen. The Calgon application was followed by injecting 50 pounds of calcium hypochlorite in solution. This second treatment was not started until the motor, suction pipe, and pump had been removed for general inspection.

Table 2
SAMPLES FROM SCREENS OF WELL No. Cu-95, 11-16-51
All values are in per cent

	O.D. 10"	I.D. 10"	O.D. 7"	I.D. 7"
Volatiles at 212° F	2.5	2.2	4.0	3.5
SiO_2	23.0	33.3	24.4	5.4
FeS	25.8	9.4	9.1	9.4
Fe_3O_4	34.3	37.2	43.8	34.6
Combustibles	9.2	4.0	3.7	8.6
$FeCO_3$	5.2	13.9	15.0	38.6

All four samples showed traces of: Calcium, Magnesium, Sodium, Chloride, and Sulphate

Approximately 17 hours were required to replace the pump, suction pipe, and motor. Then the well was surged 12 times each 4 hours for a period of approximately 27 hours, and then was pumped out.

Data were recorded before and after both Calgon treatments. These data show that the second chemical treatment of this well also failed to show any improvement.

On April 13, 1950, acidization was attempted. A dose of 3,000 gallons of 15 per cent inhibited hydrochloric acid was applied with the pump, suction pipe, and motor removed. The acid was injected through a 2-inch line, by means of a swab which worked a 20-foot section of the screen at a time. The acid was left in the well for 40 hours before pumping out operations were started.

The plot of drawdown versus flow rate, Fig. 5, shows that this acidization gave a pumpage improvement of only 50 to 75 gpm. Such improvement is negligible in comparison to results that have been reported elsewhere using this type of well cleaning.[2]

A final attempt was made to improve the drawdown and output of Well Cu-454. The well was acidized on August 24, 1950, using 1,000 gallons of 15 per cent inhibited hydrochloric acid. The acid was injected, as in previous acidizations, down through a 2-inch line and through a swab which worked a 20-foot section of the screen at a time.

After acidization, the following revisions to the well were completed:

the 150-hp motor was replaced with a 200-hp motor, two additional stages were added to the pump, giving a total of five stages, and the pump was lowered from 180 to 260 feet below the ground level.

Fig. 5, drawdown versus flow rate, shows that acidization prior to the revisions did not improve the condition of this well; while the drawdown did increase, the flow apparently was temporarily improved by 300-400 gpm due to the new pumping equipment.

Since the revision, this well became progressively lower in capacity. Though the static level had improved by 10 feet from August, 1950, to May, 1951, the drawdown has become 195 feet for a flow of 1,248 gpm, or an increase of approximately 40 feet in drawdown since the last acidization and revision of the well. This sharp increase in drawdown was attributed to the poor condition of the screen or sand caused by overpumpage of the well.

Butadiene Plant Well

In an attempt to improve the condition of Well Cu-97, one of the "500-foot" wells at the Butadiene Plant, two methods of chemical cleaning were employed. The first was chlorination, and the second was acidization with inhibited hydrochloric acid.

Chlorination was first attempted on December 29, 1948. Approximately 65 pounds of chlorine dissolved in 5,400 gallons of water was injected by pressure into the well through a 2-inch line. The line was perforated at 10-foot intervals over the entire length of the screen. A sample taken near the water surface after treatment was analyzed and found to contain 500 ppm of chlorine.

The chlorine-water solution was allowed to stand in the well for approximately 7 hours, after which about 36,000 gallons of water were forced into the well to move the chlorine-water solution through the screen and into the sand. After standing an additional 12 hours, the well was surged three times and pumped out.

An increased drawdown, calculated from data recorded before and after chlorination, indicated that chlorination had not improved the condition of this well.

The second attempt to clean this well was by the use of inhibited hydrochloric acid, employing about the same method as used at the basic refinery. On April 27, 1947, 900 gallons of 30 per cent inhibited hydrochloric acid were injected through a 2-inch line in five batches; that is, by distributing the batches of acid over 20-foot sections of the screen. A swabbing action insured a thorough distribution of the acid. The acid was left in the well for 12 hours, after which water from a fire hydrant was injected into the well for one-half hour. The acid was allowed to remain in the well another 8 hours before pumping-out operations were begun. Pumping required about 15 hours.

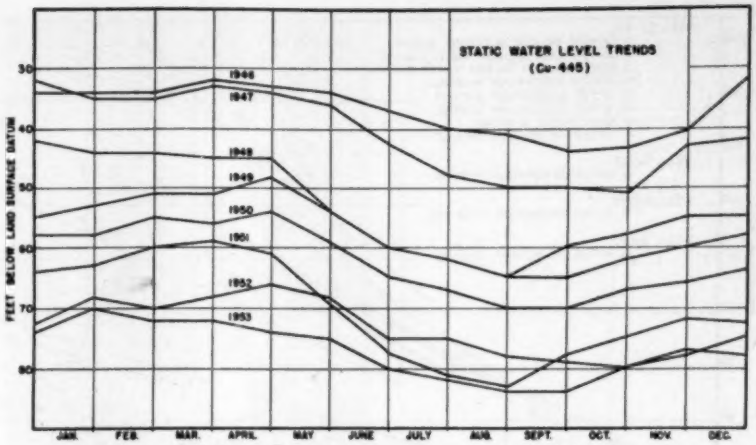


Fig. 3—TRENDS in static water level by months for eight years
Irrigation wells cause lower levels in summer months

Data recorded before and after acidization indicated that very little improvement was accomplished by the acidization. Drawdown was improved only by about ½ foot per 100 gpm. However, when a performance test was run on this well in September, 1949, test data showed a marked improvement in drawdown: as much as 3 feet per 100 gpm over data taken before acidization. The performance test was run after the pump had been lowered from 120 feet to 160 feet below ground level.

DIMENSION	WELL Cu-93	WELL Cu-94	WELL Cu-95	WELL Cu-454
A	521' 9"	522' 0"	527' 0"	540' 0"
B	402' 0"	399' 0"	399' 2"	426' 0"
C	337' 7"	323' 7"	347' 3"	342' 1"
D	68' 5"	87' 6"	66' 7"	92' 11"
E	112' 9"	107' 11"	110' 2"	102' 0"
F	3' 0"	3' 0"	3' 0"	3' 0"

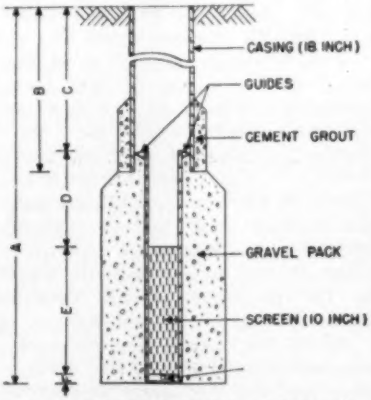


Fig. 4—CROSS SECTION, original wells

Reworking Refinery Wells

After the many attempts at cleaning the screens and sand had (for all practical purposes) failed to produce the desired results, it was decided that a complete reworking of the wells was necessary. Reworking would include installation of new stainless steel shutter type screens (Fig. 2) and gravel packs. The project of reworking was begun in November, 1951, and completed in April, 1953. The order of reworking wells was as follows: (1) Cu-95, (2) Cu-454, (3) Cu-93, and (4) Cu-94.

After each rework job a performance test was run, using a Piezometer and orifice to obtain flow data, since only well Cu-454 is equipped with a flow recorder. The results of these tests, in terms of drawdown in feet versus flow in gallons per minute, are given in Fig. 5. A good comparison can be made between before and after reworking results on well Cu-454, since Fig. 5 also includes data taken during screen cleaning attempts on the original well. At a flow of 1,300 gallons per minute, drawdown was improved by approximately 51 feet, or from 11.0 gallons per minute per foot of drawdown to 19.4 gallons per minute per foot of drawdown.

It should be noted that each rework job does not necessarily produce the same results; the results appear to be dependent on the skill of reworking. In the case of well Cu-93 (Fig. 5) it was necessary to install a new casing within the old casing, due to seepage into the well. During the cementing operation, some of the cement apparently impregnated the sur-

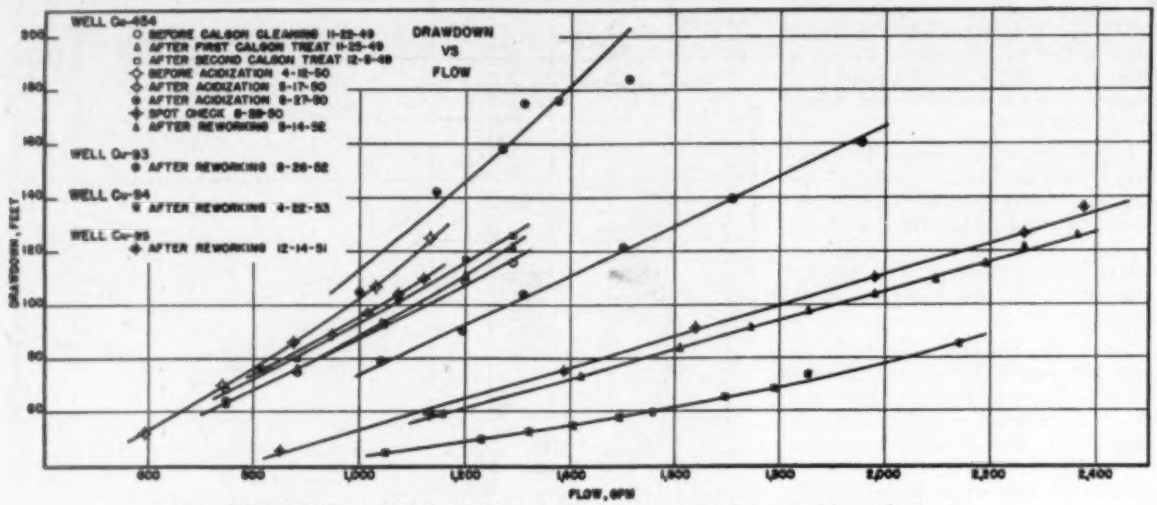


Fig. 5—DRAWDOWN vs. FLOW. Well No. Cu454 was treated with Calgon and by acidization.

rounding sand and gravel—although precautions were taken to prevent that occurrence. As a result, flow through the sand and gravel is retarded, the cement producing the same effect as a fouled screen.

When both the 10-inch main screen and 7-inch filler screen had been pulled from well Cu-95, samples of the incrustations were removed and analyzed. Table 2 gives the results of these analyses. The photograph at the head of this article shows the poor condition of the 10-inch screen which was pulled from this well. Some sections of the screen were completely plugged, while slots in other sections of the screen had been enlarged—apparently as a result of high water velocities through these sections of screen.

Conclusions

1. Acidization of these wells, using hydrochloric acid, does improve screen and sand condition in some cases, but is not always a reliable method of treatment.

2. Chlorination does not improve the condition of the screen and sand.

3. Calgon does not improve the condition of the screen and sand.

4. Injecting chemicals through a swab at the screen appears to be the most effective means of chemically cleaning a well. This method of chemical addition assures the proper concentration of the chemical at the screen and in the surrounding sand.

5. As the static water level declines, or as the condition of the screen becomes worse, lowering the pumps will increase output to some extent.

6. Temporary relief can be obtained by the addition of more pump stages, using a larger driver, and further lowering the pump — but these changes will decrease the life of the well due to overpumpage.

7. There is a need for a better method of screen cleaning for wells located in the Lake Charles area.

8. A system of replenishing the ground water supply should be developed to increase the static water level.

References

1. "Ground Water Conditions in the Lake Charles Area, Louisiana", Paul H. Jones, District Geologist, Ground Water Branch U.S. Geological Survey.
2. "How to Acidize Water Wells", M. M. Dewitt, *The American City*, October, 1947.

It Could Happen Again—and Did

Life Saved by Two-Way Radio

A combination of disregard for safety precautions and bad design of manhole frames, all but cost another sewer worker his life. Use of two-way radio on the maintenance truck of the Rochester, N.Y., Dept. of Public Works proved a life-saving operation.

John Hartman was a large man—too large to have to enter a man-hole through a 22-inch diameter manhole frame, but he did. On the maintenance truck was an air-blower but the crew being "brave men" did not use it. Result was that Hartman was overcome in the manhole 16 ft. deep. A fellow worker was likewise overcome when lowered into the manhole on a rope by other workers to rescue Hartman. It was then that the two-way radio was used to summon help from the Fire Department. Gas-mask equipped firemen were successful in rescuing Hartman after much difficulty because of the small diameter man-hole frame.

Lack of oxygen proved to be the cause of the collapse of both men, which the use of an oxygen mask on the truck blower would have prevented. There were no toxic gases detected by City Chemist Temerman. Thanks to fireman Loosman, wearing the fresh-air mask, prompt artificial respiration and oxygen administration from an inhalator rushed to the scene by the Rochester Gas & Electric Corp., Hartman is alive today.

All of this, merely because workmen would not follow safety precautions and use the safety equipment provided on the maintenance truck by the Dept. of Public Works. Furthermore, any manhole frame providing an opening of as little as 22 inches should be outlawed on modern sewer systems. Nothing smaller than a 26-in. diameter entrance should be permitted on deep manholes and large men should not be used in deep manhole work.

Again, two-way radio on maintenance vehicles has proved itself one of the greatest boons of recent years in operation and maintenance of water and sewage works.

David Morey, Jr. is Dead

David Morey, Jr., Consulting Engineer of Dallas, Texas, died on May 10th. Mr. Morey was one of the founders of the Texas Water and Sewage Works Association and was a member of the 25-year Club of that organization.

Harry A. Faber Becomes Managing Editor of Water & Sewage Works

It is with great pleasure that we announce the promotion of Harry A. Faber to the position of Managing Editor of *Water & Sewage Works*. For the past two and one-half years, Mr. Faber has been Associate Editor of this magazine.

Before joining our editorial staff, Mr. Faber was Research Chemist for The Chlorine Institute, Inc., a position he held for sixteen years. During that period, he became widely and favorably known for technical papers presented at meetings of water, sewage, and industrial waste associations in the United States and Canada. He was a frequent lecturer at short schools for plant operators, and assisted engineers in experimental studies of new processes.

Mr. Faber is a graduate of Cornell University, from which he received the degree of A. B. in Chemistry in 1930. While Instructor in Sanitary Chemistry at Cornell during the following three years, he pursued courses in sanitary engineering and acted as consultant on stream pollution problems for the New York State Departments of Health and Conservation. For two years, prior to his employment by The Chlorine Institute, he served as biochemist for the Consolidated Water Co. of Utica, N.Y., where he made studies of chlorine-ammonia treatment in the control of slime organisms in long pipe lines.

Among other contributions to the field of sanitation, Mr. Faber is credited with basic research studies which led to present concepts of free residual chlorination, to the application of chlorine for treatment of wool scouring wastes, and to the development of a chlorination process for destruction of cyanides.

He is the author of numerous technical papers, co-author of the textbook "Elements of Sanitation", and a contributor both to the "Manual of Water Quality and Treatment" and to the "Manual on Chlorination of Sewage and Industrial Wastes".

In 1948 Mr. Faber was the recipient of the Diven Medal of the American Water Works Association, and in 1949 he received the Association's Goodell Prize. He represents the Association on the Joint Editorial Board for the Tenth Edition of "Standard Methods for Examination of Water, Sewage and Industrial Waste", and is Chairman of the Board. Mr. Faber served as Vice-President of the N.Y. Sewage and Industrial Wastes Assn. during 1952, and as its President during 1953. He has been an active member of various committees of the Federation of Sewage and Industrial Wastes Assns. He is a member of the New England Water Works Assn., the American Public Health Assn., the American Chemical Society, and of Sigma Xi.

Water & Sewage Works recognizes the sound technical background and editorial ability which Mr. Faber brings to this new position. We believe that his many friends will be pleased to learn of his advancement.

E. Scranton Gillette
Publisher

L. H. Enslow
Editor

A.W.W.A. Seattle Conference

I-Highlights of Record-breaking 1954 Meeting

by **GEORGE E. SYMONS, *Ph.D., Consultant & Technical Editor, Larchmont, N. Y.***

WHEN Horace Greeley said, "Go West, young man," he probably didn't realize that by mid-20th century, the advice would read, "Go Northwest." In step with the trend, the 74th Conference of AWWA went to the Pacific Northwest—to Seattle, Washington.

Although the geographical and population centers of the United States lie in the midwest, Seattle was not too far away to draw a healthy attendance from east of the Mississippi River as well as from the near states of the west coast and northwest.

As in the past, registration did not quite come up to the advance hotel registration, but the total attendance of 2063 topped all previous registrations. Attendance at the four previous conventions was 2007, 1906, 1986, and 1896 for 1950, '51, '52 and '53, respectively. The pattern of registration at Seattle is shown by these daily totals, with Sunday the biggest single day in the history of the Association.

Pre-registration	337
Sunday	941
Monday	587
Tuesday	146
Wednesday	32
Thursday	20

A complete breakdown of the registration was not available at the time this report was prepared but it is known that there were 527 ladies present (another record). The distribution of attendance among operators, engineers, city officials, and manufacturers was of the same general order but better than in previous years, with a higher ratio of active members to manufacturers.

Association Officers—1954-55

Outgoing President	Incoming President	Vice President	Treasurer
M. B. Cunningham Supt. & Engr. Water Dept. Oklahoma City, Okla.	Dale L. Maffitt Gen. Mgr. Water Works Des Moines, Iowa	Frank C. Amsbary Vice Pres. & Secy. Ill. Wat. Serv. Co. Champaign, Ill.	W. W. Brush Editor Wat. Wks. Engr. New York City

Exhibits

No water works convention of national scope is complete without the participation of the Water and Sewage Works Manufacturers Association. This year 90 members of the WSWMA exhibited their wares in 149 booths, occupying more than 14,000 feet of floor space. As usual, the Manufacturers Association played host to the visitors and dispensed free Wenatchee apple juice.

Exhibits were held in the Civic Auditorium beginning Sunday noon and continuing daily until the close of the technical sessions on Thursday afternoon. Attendance at the exhibits was excellent.

Technical Sessions

This year, no technical sessions were held on Friday morning, but between 9:30 Monday morning and 5 P.M. Thursday evening there were ten sessions devoted to technical papers plus business sessions of the four divisions: Water Purification, Water Resources, Water Works Management, and Transmission and Distribution. With two exceptions each technical session was opened with a motion picture.

Moderated symposia were held on Watershed control, Chlorination stations, Tastes and Odors, Regional-metropolitan water systems, Oil pipe line crossings, and Fire insurance ratings. Committee reports were presented on Instrumentation and Radioactivity, Meters, Butterfly Valves, Sluice Gates, Air conditioning, Employment and Safety. In addition, the Water Purification Division scheduled seven committee reports. There were ten original papers, some with scheduled discussion. All told, 67 persons took part in the scheduled program and many times that number in floor discussions.

Inspection trips to the Seattle Water Dept. were held daily.

The Social Whirl

The opportunity to meet and greet all fellow conventioneers came first on Sunday night at the Washington Athletic Club. This buffet supper and evening of entertainment was called the "Potlatch and Pow Wow", with food from 6 to 9 and entertainment from 9 to 11. The local committee had guaranteed 525 dinners but they actually served 768.

Monday saw the annual golf tournament held at the Championship Inglewood Country Club along the shores of Lake Washington. Sixty-seven took part in the matches, including five ladies. Among the winners were:

Low Net—Operator ..... Mel Hatcher, Kansas City

Low Gross—Operator ..... George McDonough, Wanaque, N. J.

S. F. Newkirk, Jr.
Engr. & Supt.
Bd. Wat. Comm.
Elizabeth, N. J.

Honorary Membership

L. N. Thompson
Engr. & Gen. Mgr.
Water Dept.
St. Paul, Minn.

Ben S. Morrow
Engr. & Gen. Mgr.
Bur. Wat. Wks.
Portland, Ore.

Low Net—Manufacturer .....
.....Marv Shroeder, Vancouver, Wash.
1st Low Gross—Open.....
.....E. Scranton Gillette, Chicago
Low Net—Ladies.....Mrs. Ted McKay
Low Gross—Ladies.....Mrs. Frank Mueller

Monday night combined the presentation of the Annual AWWA Awards with a reception for the officers and a dance. Awards conferred that night included Honorary Membership, the Diven Medal, the Goodell Prize, and the Fuller awards.

Diven Medal
W. J. Orchard
Wallace & Tiernan
Newark, N. J.

Goodell Prize
M. J. Taras
Res. San. Chem.
Water Dept.
Detroit, Mich.

Tuesday night festivities consisted of Klondike Kickup, with games to play, dancing and professional entertainment. Costumes reminiscent of the 1890's with bowler and bustles added to the gaiety as did some handsome prizes for those whose luck ran best at the gaming tables. Prizes for the best costumes went to Mrs. Robert Park, Seattle, as a dance hall girl and to Reg Hays of Hydraulic Ser. Corp. as an Eskimo. Gambling was strictly amateur with stage money but the prizes for the best players were anything but phony.

Adding to the festivities was the Starlight Cruise on Wednesday night, an optional boat trip from Lake Washington through the Canal and Lake Union to Puget Sound—from fresh water to salt. More than 425 persons took the trip. Three boats were used and the stars did come out. Except for the chill in the air this was one of the most enjoyable features of the meeting.

Climaxing the social events was the annual inaugural banquet and ball, featuring talks by retiring president Cunningham of Oklahoma City, Okla. and incoming president Dale Moffitt of Des Moines, Iowa and a "visiting" Professor from Sweden. Dale Moffitt received a citation from the Governor of Iowa. "Bill" Orchard announced the establishment of the Harry E. Jordan Fund for students, to be awarded annually by the Manufacturers Association. The banquet dinner was a Puget Sound menu of salmon. Dancing followed in the Spanish Room of the Olympic Hotel. Mrs. Ralph Lancaster of Kearney, Neb., won the annual directors contest of "guessing the attendance," having picked 2063 on the nose.

"Strictly for the ladies" were a "Belles Brunch" at ten on Monday morning at the Washington Athletic Club and a "Seattle Tour" on Tuesday afternoon. Throughout the week a "Ladies Rendezvous" was available from 10 A.M. to 5 P.M. in the lounge of Seattle's leading department store. For those wives, whose husbands raised no objections, the store issued credit cards to simplify buying. Other times the ladies were either left to do as they wished except in the evenings when they were much in evidence and demand at the social functions.

For the benefit of sightseeing-minded, the usual Friday Technical session was cancelled and two tours were offered: one to Bremerton, Washington from 10 A.M. to 4:30 P.M.; the other to Victoria, B. C. between 8 A.M. and 9 P.M. The Bremerton trip included a ride on the Black Ball Ferry Line, a tour of the Puget Sound Navy Yard and a return bus trip via the famous Narrows Bridge and Tacoma. The Victoria trip, by steamer, included a lunch at the Empress Hotel, and a tour of the beautiful Butchart Gardens.

For the vacation-minded, there were two extended sightseeing trips, going to and coming from the convention city. On the outward bound trip some 82 persons left New York on May 14 (or joined the tour en route) and journeyed via Chicago, Grand Canyon, Los Angeles, Fresno, (California) and Yosemite National Park, Glacier Point, Merced, (Calif.), San Francisco, Portland, (Ore.) and the Columbia River Highway and Bonneville Dam, with appropriate stopover time to view the beauties in which these various spots abound.

Association Secretaries

Secretary
Harry E. Jordan
New York City

Exec. Asst. Secy.
Raymond J. Faust

On the return trip, sightseers visited Sun Valley, Idaho, Colorado Springs, Colorado, Pike's Peak, Garden of the Gods, St. Louis and return. Conventioneers who were pressed for time had direct train service via Pennsylvania Railroad, and the Empire Builder of the Great Northern Railway, and those who were really rushed flew fast air transport. A few hardy souls made a side trip to Alaska on an eight day post-conference all expense boat tour.

In recognition of his services as transportation chairman, the tour members presented E. A. Sigworth with a wrist watch.

Manufacturers Luncheon

Among the special meetings was the annual luncheon of the Water and Sewage Works Manufacturers Association held on Wednesday noon. More than 345 members-representatives and guests attended and heard a highly interesting talk by Walter J.

Program
Richard Hazen
Partner
Hazen & Sawyer
New York City

Transportation
E. A. Sigworth
Ind. Chem. Sales Div.
W.Va. Pulp & Paper Co.
New York City

Com. Mgmt.
R. W. Morse
Supt.
Water Dept.
Seattle, Wash.

Local Facilities
M. S. Campbell
Engr.
H. D. Fowler Co.
Seattle, Wash.

Committee Chairmen

Local Trans.
W. W. Tinniswood
Civ. Engr. Dept.
Univ. of Idaho
Moscow, Idaho

Awards
F. Merryfield
Prof. San. Eng.
Univ. of Oregon
Corvallis, Ore.

Standing Comm. Chairmen

W. W. Practice
L. R. Howson
Cons. Engr.
Chicago,
Ill.

W. W. Administration
W. R. La Due
Gen. Mgr.
Wat. & Sew. Dept.
Akron, Ohio

A.W.W.A. Directors
Representing WSWMA

E. M. Jones
Vice Pres.
Simplex Valve Co.
Philadelphia

H. F. O'Brien
Pres.
A. P. Smith Co.
E. Orange, N. J.

DeLong, Director of Public Information, Weyerhaeuser Timber Co.

New members elected to the Board of Directors of WSWMA included:

Wallace & Tiernan, Inc.....Newark, N. J.
Lock Joint Pipe Co...E. Orange, N. J.
The American City....New York City
B-I-F Industries, Inc.....Providence, R. I.
Roberts Filter Co.....Darby, Pa.

Following the meeting, the Board of Directors held its annual election. The following officers will serve for the year beginning Jan. 1, 1955:

President—Harvey S. Howe, Lock Joint Pipe Co.
Vice President—J. A. Frank, National Water Main Clean. Co.
Treasurer—Hubert F. O'Brien, A. P. Smith Co.

John G. Stewart continues as manager and Dorothy E. Dimmers as Secretary.

Special Meetings

Other special meetings included the Fuller Award Society Breakfast, the Pacific Northwest Section Luncheon, and the Wisconsin Section Breakfast.

Honors and Awards

Presentation of awards and citations on evening set aside for this function included the following:

Honorary Membership to:

SAMUEL F. NEWKIRK, Engineer and Superintendent, Board of Water Commissioners, Elizabeth, N. J. for his service to the Association as President, Vice President, Director and particularly as Chairman of the Committee on Meters since 1938 during which time five meter specifications were developed. In the absence of Mr. Newkirk, the award was received for him by E. A. Sigworth.

LEONARD N. THOMPSON, Engineer and General Manager, Water Department, St. Paul, Minn. for his services as President, Vice President, Director, member of several committees, and a participant in Divisional activities. In the absence of Mr. Thompson, the award was received for him by Milton Rosen.

BEN S. MORROW, Engineer and General Manager, Bureau of Water Works, Portland, Oregon, for his loyal service since 1926, as a Director and member of many committees, including his present membership on the Committee on Watershed Protection and Erosion Control.

The *Diven Memorial Medal* to:

WILLIAM J. ORCHARD, Director, Wallace & Tiernan, Inc., in recognition of his many years of devotion to the Association and to the water supply industry. Mr. Orchard was also presented an award from AIDIS for his part in sponsoring that organization's inception.

The *Goodell Prize* to:

MICHAEL J. TARAS, Res. San. Chemist, Dept. of Wat. Sup., Detroit, Mich. for his paper titled, "Effect of Free Residual Chlorination on Nitrogen Compounds in Water" published in the January issue of the AWWA Journal.

President
R. S. Rankin
Asst. Mgr. N. A. Sales
Dorr Co.
Stamford, Conn.

Wat. & Sew. Wks. Mfg. Assn.
Vice President
Harvey S. Howe
Vice Pres.
Lock Joint Pipe Co.
Orange, N. J

Manager
John G. Stewart
WSWMA
New York City,
N. Y.

Secretary
Dorothy Dimmers
WSWMA
New York City,
N. Y.

W. W. Management
N. S. Bubbis
Gen. Mgr.
Wat. & San. Dist.
Winnipeg, Man.

Division Chairmen
Water Resources
A. D. Henderson
Cons. Engr.
Hydrotechnic Corp.
New York, N. Y.

Water Purification
W. Yegen
Supt.
Filtration Plant
Bismarck, N. D.

Trans. & Distribution
M. K. Socha
Head, W.W. Sup. Div.
Dept. of Wat. & Pow.
Los Angeles, Calif.

The Fuller awards were made to the following representatives of the several sections:

J. A. Carollo	Arizona
W. O. Weight	California
A. U. Sanderson	Canada
E. A. Schmitt	Chesapeake
J. M. V. Roig	Cuba
S. Keith Keller	Florida
W. W. Deberard	Illinois
R. B. Wiley	Indiana
R. O. Ellis	Iowa
D. F. Metzler	Kansas
W. H. Lovejoy	Ky-Tenn.
E. E. Norman	Michigan
E. W. Johnson	Minnesota
H. O. Hartung	Missouri
M. E. Henderson	Montana
J. W. Cramer	Nebraska
R. W. Esty	New England
M. E. Flentje	New Jersey
R. W. Austin	New York
W. G. Brown	No. Carolina
A. A. Ulrich	Ohio

R. E. Koon	Pacific Northwest
J. D. Johnson	Pennsylvania
Sherman Russell	Southeast
F. S. Taylor	Southwest
H. A. Johnson	Virginia
J. J. McCarthy (deceased)	Wisconsin

Sixteen of the awardees were present to receive the award.

Section Awards

The *Hill Cup* awarded for membership growth in 1953 went to the Southwest Section which had a point score of 50.505. Runner-up was the Pacific Northwest Section with a point score of 18.795 and in third place was the Southeastern Section with 17.825.

The Franklin Henshaw Cup emblematic of the section having the highest membership attendance at an annual meeting was awarded to the Pacific Northwest Section for a percentage attendance of 67.5. California was runner-up with 62.3 percent and Rocky Mountain third with 60.3 percent.

And for the fourteenth time since 1939, the *Old Oaken Bucket* was presented to the California Section for having the largest membership with 1056. Second was the Southwest Section with 915 and trailing in third place was New York with 738 members.

California
Burt S. Grant
Ch. Engr. & Asst. G.M.
Dept. Wat. & Pow.
Los Angeles, Calif.

Chesapeake
D. V. Auld
Director
San. Engr.
Washington, D. C.

Florida
W. W. Gillespie
Cons. Engr.
Smith & Gillespie
Jacksonville, Fla.

Illinois
Ed. E. Alt
Sales Rep.
Chi. Bridge & Iron
Chicago, Ill.

New Directors

Division Officers

Elected to serve as Division officers for the coming year were the following:

WATER WORKS MANAGEMENT DIVISION

Chairman

N. S. Bubbis
Gen. Mgr. Water & Sew. District
Winnipeg, Canada

Vice-Chairman

D. L. Erickson
City Engineer
Lincoln, Nebraska

Secretary

L. M. Grayson
Ch. Engr. & Gen. Mgr.,
Pub. Serv. Dept.
Glendale, Calif.

Trustees

Tom Skinker
St. Louis
W. W. Deberard
Chicago

WATER RESOURCES DIVISION

Chairman

A. D. Henderson
Cons. Engr. Hydrotechnic Corp.
New York City, N. Y.

Vice-Chairman

B. S. Grant
Department of Water & Power
Los Angeles, Calif.

Secretary

H. C. Barksdale
Dist. Engr.
U.S. Geological Survey
Trenton, N. J.

Trustees

C. H. Bechert
Indianapolis
J. W. Cramer
Lincoln, Neb.

WATER PURIFICATION DIVISION

Chairman

Wm. Yegen
Supt. Filtration Plant
Bismark, N. Y.

Montana
Claude W. Eyer
City Engr.
Water Dept.
Glendive, Mont.

Ohio
L. J. Hoffman
Supt. Dist.
Bur. Wat. & Sew.
Akron, O.

Southwest
J. R. Pierce
V. P. & Gen. Mgr.
Gen. Wat. Wks. Corp.
Pine Bluff, Ark.

W.S.W.M.A.
Carl N. Brown
Sales Mgr.
U. S. Pipe & Fdry.
Birmingham, Ala.

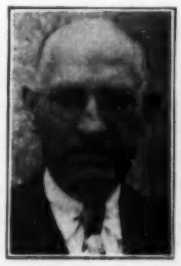
New Directors

Arizona
J. A. Carollo
Cons. Engr.
Phoenix, Ariz.

Canada
A. U. Sanderson
Wat. Wks. Engr.
Dept. of Works
Toronto, Ont.

Chesapeake
E. A. Schmitt
Retired
Wat. Sup. Div.
Washington, D. C.

Florida
S. Keith Keller
Gen. Supt.
Pinellas County
Clearwater, Fla.



Illinois
W. W. Deberard
City Engr.
Chicago,
Ill.

Indiana
R. B. Wiley
Head Civ. Engr.
Purdue Univ.
W. Lafayette, Ind.

Fuller Awards

New England
Roger W. Esty
Mfrs. Rep.
Danvers,
Mass.

New Jersey
M. E. Flentje
Res. Engr.
Am. Wat. Wks. Co.
Philadelphia, Pa.

Fuller Awards

New York
R. W. Austin
Hyd. Engr.
Pub. Serv. Comm.
Albany, N. Y.

Ohio
A. A. Ulrich
Manager
Ohio Wat. Ser. Co.
Massillon, Ohio

Southeast
Sherm. Russell
Supt.
Wat. Purif.
Atlanta, Ga.

Vice-Chairman
H. C. Medberry
Sr. Engr., Water Dept.,
San Francisco, Calif.

Secretary
H. H. Gerstein
Asst. Ch. Engr., Wat. Dept.
Chicago, Ill.

Trustees
Paul D. Haney
Washington, D.C.

Sherman Russell
Atlanta, Ga.
W. W. Aultman
Miami, Fla.

TRANSMISSION & DISTRIBUTION SYSTEM

Chairman
M. K. Socha
Head, W. W. Sup. Div.
Los Angeles Wat. & Pow. Dept.
Los Angeles, Calif.

Vice Chairman
F. E. Dolson
Supt. of Dist., St. Louis Co. Wat. Co.
University, Mo.

Secretary
H. W. Niemeyer
Supt. of Dist., Indianapolis Water Co.
Indianapolis, Ind.

Trustees
E. S. Cole
New York City
B. E. Payne
Louisville, Ky.

Ky.-Tenn.
W. H. Lovejoy
Supt. Purif.
Water Co.
Louisville, Ky.

Fuller Awards

Michigan
E. E. Norman
Manager
Light & Water Util.
Kalamazoo, Mich.

Minnesota
E. W. Johnson
Engineer
Water Dept.
Minneapolis, Minn.

Missouri
H. O. Hartung
Prod. Supt.
St. Lou. Cty. Wat. Co.
University City, Mo.

Next Year

The 75th Annual meeting, which begins the 75th year, will be held in Chicago on June 13-17 and the 76th meeting honoring the Diamond Jubilee year will be in St. Louis in 1956. The 1957 meeting will be in Atlantic City. (ED. NOTE—Reports on technical sessions will appear in the Aug. issue.)

Water for Happy Gardening

"Enough But NOT too Much!"

"Harry Greenthumb" is a happy Long Island home owner who knows how to keep his lawn velvety and his shrubs lush. He tells his neighbors what he has learned about watering and fertilization in a useful booklet on gardening published by the Jamaica Water Supply Co. for distribution to its 95,000 residential customers.

As a dramatic contrast to happy "Harry," whose dictum is "Enough but not too much," the booklet introduces puzzled Waldo P. Commuter. This is the chap who rushes home every evening and conscientiously hoses down his property but somehow his grass looks beat and his shrubs discouraged. He learns that soaking, *not sprinkling,* is the key to "Harry's" success.

Written by a recognized Long Island gardening authority and endorsed by the Queens Botanical Garden Society, the booklet recommends infrequent, but *thorough* soaking of lawns and plants for best results. A very simple method for determining what is a "thorough soaking" is described. Frequent light sprinkling by hand, it warns, is worse than no water at all. It is wonderful for producing weeds and vulnerable shallow grass roots.

Under the title, "How Green is YOUR Garden?," the booklet describes the ABC's of lawn care and gardening in simple language. Easy to follow directions are given on when and how to water lawns, trees and shrubs, how and when to fertilize, how to select the right kinds of trees and plants, soil preparation, transplanting, and other topics of interest to home gardeners.

A reference list of books and pamphlets for more serious students of gardening is also included.

In a foreword, Daniel J. Hennessy, president of Jamaica Water Co., states that the booklet has been published as a public service to the company's customers and friends, "to contribute to your gardening pleasure and enable you to make more skillful use of water—our most important natural resource."

We recommend to our readers that they take a look at "How Green is YOUR Garden?" by requesting copies from D. J. Hennessy, Pres., Jamaica Water Supply Co., Jamaica 1, N.Y.

WATER WORKS PRACTICES

Hydraulics

The Thirteenth in a Series

by GEORGE E. SYMONS, Ph.D., Consultant & Technical Editor, Larchmont, N. Y.

HYDRAULICS is the study of principles that control the behavior of liquids, especially water, both at rest and in motion. The design and operation of water works involve problems in the storage and flow of water, and hence involve hydraulics.

Hydrostatics is that branch of hydraulics which deals with the problems of water at rest. Hydrodynamics deals with problems of flow in pipes, conduits, pumps and distribution systems. Flow measurement is that part of hydrodynamics which concerns the determination of qauntity of liquid in motion.

A . . . Hydraulic Units

1 . . Concept of Quantity and Flow

a. Quantity is an amount of liquid. It may be measured by determining volume or mass (weight) of a liquid confined in a structure, vessel, device, tank, pipe, etc.

b. Flow is quantity in movement from one point to another, or past a point, in a specified interval of time.

2 . . Basic Units

a. The three primary units of measurement in hydraulics are length, weight and time.

b. In the U.S. and England, these primary units are the foot, pound and second.

c. Where the metric system is used, the corresponding units are the meter (3.28 ft.), kilogram (2.2 lb.) and second.

d. Dimensions, such as diameters of pipes and flow measuring devices should be expressed in feet and decimals of a foot for substitution in hydraulic formulas. (If expressed in inches, or feet and inches, it should be so stated.)

3 . . Units of Volume and Flow

a. Volume.

(1) Cubic foot—A convenient unit for expressing small quantities of water in tanks and small reservoirs.

(2) Gallon—A volume of 231 cu. in., this unit is generally used in connection with water supplies. Reservoir capacities may be stated in million or billion gallons.

. . . One cu ft. equals 7.481 gal.

. . . One British Imperial gallon (Imp. gal.) equals 1.2 U.S. gal.

(3) Acre-foot—The volume of water required to cover one acre to a depth of one foot, or 43,560 cu. ft. This unit is used in reservoir storage calculations.

b. Flow

(1) Cubic feet per second (cfs). Often called second-feet, and sometimes called cusecs, it is a measure of volume moving during one second of time.

. . . The cfs unit is used principally in stream flow measurement; cubic feet per minute (cfm) is used in air or gas measurement.

(2) Gallons per minute (gpm). Capacities of pumps and water flow in mains is measured in gallons per minute. Capacity of water plants, filters, etc. is usually stated in gallons per 24 hours or gallons per day (gpd), or in million gallons per day (mgd).

(3) Inches per month or inches per year is the unit used to express runoff of a drainage basin or the evaporation from a reservoir, but the area involved must be stated if volume is desired.

This article is one of a series on the general subject of "Water Works Practices," developed by Dr. Symons in the simple style of a short course lecture and designed to be of interest to small plant operators, new operators, students and many others who may wish to review the fundamentals of the subject.—*The Editors*

B . . . Hydrostatics

1 . . Weight of Water

a. Water has its maximum density at 3.98°C or 39.13°F when its specific gravity is 1.00. Above or below that temperature the relative density is less than 1.00.

b. At 3.98°C, one cu. ft. of water weighs 62.42 lb., and one gallon weighs 8.345 lb.

c. At 15.6°C or 60°F, one cu. ft. of water weighs 62.36 lb. and one gallon weighs 8.34 lb.

d. Chemicals in solution in fresh water do not materially affect the weight of water.

2 . . Pressure

a. *Pressure* is the force acting on a unit area of surface. It is expressed in pounds per square inch (psi) or in Kg per sq cm.

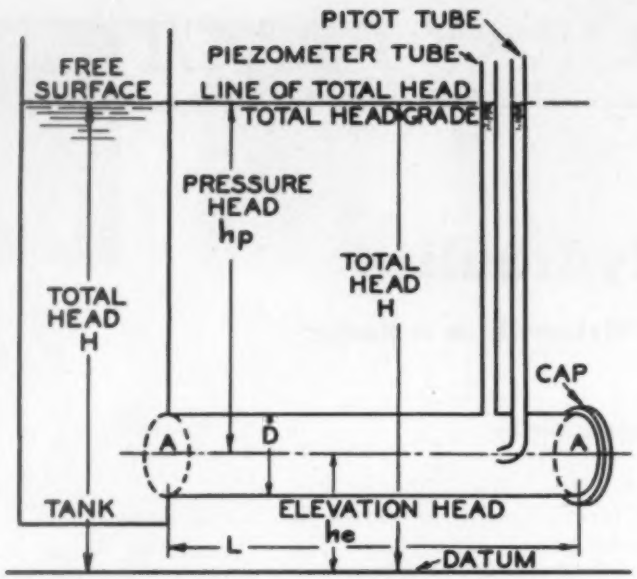
b. *Atmospheric pressure* varies with meteorological conditions and decreases as altitude increases.

. . . Mean atmospheric pressure at sea level is 14.7 pounds per square inch designated as 14.7 psi or one atmosphere.

. . . One atmosphere of pressure equals the pressure produced by a column of water 33.90 feet high (equal to a column of mercury 29.92 inches or 760 mm high). Since this relationship (called pressure head) exists between height (elevation) of water and pressure in pounds per square inch, pressure heads are frequently expressed in terms of feet of elevation, called head in feet—2,308 ft. equals 1.0 psi.

. . . If air is completely exhausted from a tube closed at one end and with the open end submerged in water at sea level, the water will rise to a height of 33.9 ft., less some small distance because of vapor pressure.

b. *Vapor pressure* is the force exerted by a vapor in a confined space and it exists at the surface of any



(From Keep Sheet No. 23, B-I-F Industries)

Fig. 1—WATER in pipe, under pressure, not flowing

liquid when the space above the liquid is confined.

. . . Vapor pressure increases with temperature and equals atmospheric pressure at the boiling point of the liquid. See Table 1.

Table 1

AQUEOUS VAPOR PRESSURE IN FEET OF WATER*

Temp. °F	V.P. in Ft.	Temp. °F	V.P. in Ft.
32	0.204	130	5.13
40	0.281	140	6.67
50	0.411	150	8.58
60	0.591	160	10.95
70	0.836	170	13.83
80	1.17	180	17.33
90	1.61	190	21.55
100	2.19	200	26.59
110	2.95	210	32.58
120	3.91	212	33.90

*From King's Handbook of Hydraulics

c. *Hydrostatic Pressure* is the force exerted on a unit area by a body of water at rest. The pressure at any point is normal to the surface on which it acts and of equal intensity in all directions.

. . . The intensity of pressure on any submerged surface is directly proportional to the specific weight of the fluid times the depth of submergence.

. . . The pressure at any point in a body of water with a free (unconfined) surface is equal to the sum of the pressure of the water above it and the atmospheric pressure. This is called absolute pressure and is designated as psia and is equal to psig + 14.7 (i.e. pounds per square inch gage pressure + 14.7 lb.)

3 . . PRACTICAL IMPORTANCE

a. Pressure forces against dams and under dams on rock and earth foundations are practical considerations of hydrostatics and important in the design of impounding reservoirs.

b. Hydrostatic pressure is the important consideration in the height of elevated storage tanks. (230.8 ft. equals 100 psi). Table 2 shows the relation of elevation, or head in feet, to hydrostatic pressure in psi.

C . . . Hydrodynamics

1 . . GENERAL PRINCIPLES

a. The simplest method of developing or expressing basic laws and relationships of hydraulics is to consider the power (energy) carried by water.

Table 2

HYDROSTATIC PRESSURE FOR DIFFERENT ELEVATION HEAD*

(Weight of Water at 62.4 lb. per cu. ft.)

Head in ft.	psi	Head in ft.	psi
10	4.33	110	47.67
20	8.67	120	52.00
30	13.00	130	56.33
40	17.33	140	60.67
50	21.67	150	65.00
60	26.00	160	69.33
70	30.33	170	73.67
80	34.67	180	78.00
90	39.00	190	82.33
100	43.33	200	86.67

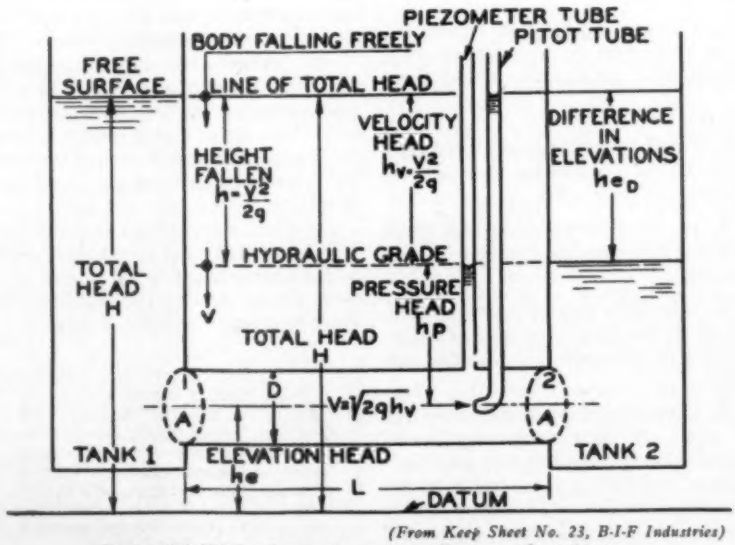
*From King's Handbook of Hydraulics

b. Power or energy in flowing fluids exists because of elevation, velocity or applied pressure, or any combination of these three. Each of these sources of energy can be converted into the other two. Any one of these three energy producing factors can be expressed in terms of head in feet or lb. per sq. in. (psi)

c. The total energy or total head is equal to the sum of these three factors, except that in flowing water this total head is reduced by friction.

d. Water flowing in open channels has no pressure but will have velocity and elevation. For the most part, water flow and considerations of hydraulics in water systems is concerned with water confined in pipes under pressure.

e. The effect of temperature on pressure and rate of flow is so slight that it is neglected in practice. The effect of temperature on the density and viscosity of water is measurable and these two factors do have an effect on flow. Pressure has practically no effect on the volume of a liquid; water is practically incompressible.



(From Keep Sheet No. 23, B-I-F Industries)

Fig. 2—WATER in pipe, under pressure, flowing without friction

2 . . Definitions

a. *Total Head* (H)—The sum of elevation head, pressure head and velocity head at any point in a system.

b. *Elevation Head* (h_e)—The potential energy or power (pressure energy per unit weight) of water because of its height or elevation above some arbitrary point, called the datum. In practice, since it is differences in elevation that are important, elevations may be measured above any datum. (see Fig. 1)

c. *Pressure Head* (h_p)—The pressure energy per unit area exerted against the walls of the structure or pipe expressed in psi. It may also be expressed in terms of feet (1.0 lb. equals 2.308 ft.). It is the only part of total head which can be measured by a piezometer pipe, manometer, or pressure gage. (see Fig. 1)

d. *Velocity Head* (h_v)—The height to which water would rise freely at any point due to kinetic energy or energy of motion at that point. (see Fig. 2)

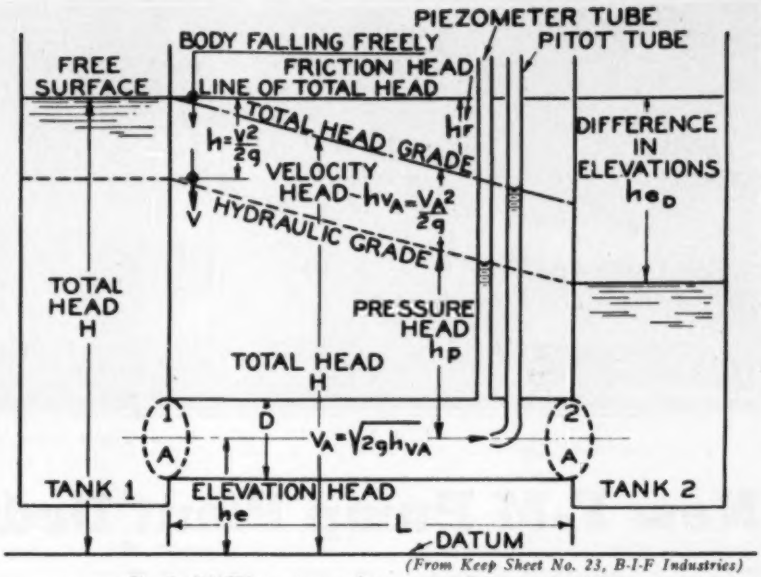
e. *Friction Head* (h_f)—The head or energy lost by water, passing from one point to another, due to turbulence, pipe roughness, valves, elbows, and fittings; and to friction forces in the moving water. The difference in total head between two points on a system on the same elevation is the head loss due to friction. (see Fig. 3)

$$h_e + h_p + h_v = H - h_f \qquad \text{Eq. 1}$$

f. *Positive Head*—Generally called simply, head, it is the vertical distance, (usually stated in feet) above any given point on a selected base line of a system, to which the pressure velocity, and elevation of a liquid would cause that fluid to rise in an open ended tube against atmospheric pressure. This is a restatement of the definition of total head.

g. *Negative Head*—The vertical distance below any point on a selected base line of a closed system, through which a less-than-atmospheric pressure of a liquid would cause that liquid to drop in a U-Tube open to the atmosphere at one end; that is, negative head is a linear measurement of a partial vacuum in terms of head. Vacuum is usually expressed in mm. or inches of mercury but negative head is frequently expressed in feet of water.

h. *Hydraulic Grade Line*—A line, in any selected vertical plane, connecting all points representing the pressure head in any system. The energy line or total head grade line is above the hydraulic grade line by the kinetic energy or velocity head ($V^2/2g$) see Fig. 3.



(From Keep Sheet No. 23, B-I-F Industries)

Fig. 3—WATER in pipe, under pressure, flowing with friction

i. *Hydraulic Gradient Line*—The slope of the hydraulic grade line at any point.

3 . . Flow Measurement

a. Reasons for flow measurement in water works practice.

(1) To indicate plant production rates.

(2) To establish plant production totals.

(3) To provide records for public health departments and for reports to taxpayers, management and stockholders.

(4) To determine output and efficiencies of operating units such as filters, pumps, etc.

(5) To control treatment devices such as chemical feeders.

(6) To control operating rates of pumps, filters, etc.

(7) To determine rates of unit operations.

(8) To provide a basis for determining operating costs.

(9) To ascertain unaccounted-for water.

(10) To determine quantities sold.

b. Methods of Flow Measurement

(1) Open channel flow may be measured by head-area meters, such as weirs, measuring flumes, open end nozzles or by velocity meters.

(2) Confined flows may be measured by differential-head meters, velocity meters, Pitot tubes, etc.

(3) The subject of the hydrodynamics of flow measurement including methods, devices and calculations will be presented in the next lecture.

4 . . Loss of Head

a. In every aspect of flowing water, friction forces are adversely at work. It is these friction forces which reduce the power or energy in flowing water and hence reduce its pressure and rate of flow as it moves through any system. Since the energy lost can be expressed in terms of head, friction head is usually referred to as "loss of head."

b. Loss of head is so important in flow measurement, distribution and pumping, that a whole lecture will be devoted to the subject.

5 . . Pumping

a. Hydrodynamics is an essential part of pumping and pump operation, having to do with suction lift, discharge, head loss, pump characteristics, etc.

b. Pumps and pumping will be discussed in a forthcoming lecture.

D . . . References

The material in this lecture is based on these sources:

King, H. W., "Handbook of Hydraulics" (McGraw-Hill)

Angus, R. W., "Hydraulics for the Practical Operator" (*Water & Sewage Works: 95*, R-13, 1952)

"Keep Sheet No. 23—Water Flow in Pipes" (B-I-F Industries, Inc.)

(For detailed information on the subject of hydraulics, hydraulic formulas and hydraulic tables reader is referred to these references or others on the subject.)

Next Lecture

Flow Measurement

NEW F-M PUMP PLANT at Kansas City in dedication dress.

New F-M Pump Plant Dedication

Congressman Scrivener and Governor Arn of Kansas participate; Secy. of Commerce Weeks wires well wishes; many prominent engineers in attendance.

WITH the most impressive dedicatory arrangements ever witnessed by this writer, Fairbanks-Morse & Co. during the four-day period of May 18-22 threw open to the technical and business press, the engineering profession, F-M pump users and the general public, their new pump manufacturing plant located at Kansas City, Kansas.

On a plant site of 38½ acres, this new plant, said to have cost in the neighborhood of $6,000,000, is comprised of an ultra-modern foundry occupying an area of 147,600 sq. ft. and the pump manufacturing plant, research and testing department and nation-wide Pump Sales Division, occupying an additional 180,000 sq. ft. —327,600 sq. ft. in all.

The new Kansas City plant is the ninth F-M plant in the U.S., with the tenth in Mexico and eleventh in Canada. Pumps are manufactured at plants in Beloit, Wis., Pomona, Calif., Stuttgart, Ark., St. Louis, Mo., and Kansas City, Kan. Henceforth, all centrifugal pumps of 16 in. size and smaller will be manufactured at the new plant. Turbine-type pumps are manufactured at Pomona, Calif. Pumps larger than 16 in. size, including the giant drainage-irrigation pumps (later referred to) will continue to be manufactured in the Beloit, Wis., plant.

Technical Press Day

On May 19, between 45 and 50 editors of technical and business magazines came to Kansas City as guests of Fairbanks-Morse & Co., to be dined and wined; briefed on the new pump manufacturing plant; hear company history during its 124-year life; meet the Morses of the third and fourth generation; inspect the most modern of modern foundries; see pumps cast, machined, assembled and tested; watch demonstrations of centrifugal pump phenomena; see pump performance, including that of the recently perfected F-M Bladebar Trash Pump pumping live goldfish and rags by the yard; witness a remarkable demonstration of cavitation and methods of correction; see how carefully pump impellers are balanced; watch a model test for the largest drainage pumps in the world and see a $250,000 116-in. drainage pump (360,000 gpm capacity), requiring 3 flat cars for delivery to Belle Glade, Fla., for drainage and irrigation duty. Three other pumps of the same size had already been delivered.

Keynoter
Dr. Richard Folsom
Univ. of Michigan

Luncheon Speaker
Mr. Gail Hathaway
U. S. Engineers

Dr. Folsom was caught unaware during the inspection of 20-in. test model pump in operation.

In regard to the latter, word came through from Florida during the inspection tour that Fairbanks-Morse & Co. had also been the successful bidder on four more drainage pumps of 144-inch size to lift 405,000 gpm from the Florida Everglades into drainage-irrigation ditches, at a bid price of more than $700,000 for the four pumps.

The day closed with a Chamber of Commerce dinner given in honor of F-M's president Robert H. Morse, Jr. (3rd generation of Morse ownership and management) at which the Hon. E. P. Scrivner, congressman from the Kansas City District, was the speaker of the evening. Speaking on "Americans Unafraid," he cited the decision of F-M management to invest its millions in this new plant at a time when fears were felt that some sort of business recession was just around the corner, while war clouds blanked out the horizon of "peace on earth," with its threat to initiative and private enterprise. Along this same line of commendation of the Fairbanks-Morse decision to proceed with confidence in what's ahead, Secretary of Commerce Week's lengthy telegram to President Morse emphasized that: "Faith in the future shown by companies like yours typifies the spirit of industrial leadership that is doing so much to stimulate economic growth. My best

Several of the Panel and Moderator

Dr. Knapp of Cal. Tech., moderator; Prof Hollander of Cal. Tech.; Dan Rankin, Chief Engr. Peerless Pumps; L. H. Kessler, F-M's Chief Hydraulics Engr.; Konrad Kick, F-M's Chief Design Engr.

Director and Genl. Chairman

Henry J. Barbour, F-M's Director of Public Relations, and Dean F. M. Dawson (Univ. Iowa) Genl. Chairman of the technical program.

wishes for your continued growth and service to America."

Engineer's Day

May 20th was "Engineer's Day" in the 4-day dedication activities. Hydraulics experts, consulting engineers, operating engineers, users of F-M pumps, teachers and department heads at universities flocked in from the four corners—from the Atlantic to the Pacific and Canada to Mexico. These engineers came to participate in, or listen to, a review of pumping progress and pump improvements as well as shortcomings. A panel discussion by leading pumping experts of the country under leadership of F. M. Dawson, dean of engineering at the Univ. of Iowa, proved the day's highlight which brought to the dedication an estimated attendance of 1,000 to 1,200 engineers, including F-M field engineers and sales engineers.

The forenoon was devoted to the impressive technical program—unique in the history of pump manufacturing—because of the number and standing of experts invited to participate by Dean Dawson on behalf of the Fairbanks-Morse management. Here is the roster of America's leading hydraulics experts who appeared on the platform with Dean Dawson:

Richard C. Folsom
Director of Engineering Research
Univ. of Michigan

Gail A. Hathaway
Special Ass't. to Chief of Engrs.
Dept. of the Army

Robert T. Knapp
Prof. of Hydraulic Engineering
California Inst. of Technology

James W. Daily
Assoc. Prof. of Hydraulic Engineering
Mass. Inst. of Technology

Aladar Hollander
Prof. Emeritus and Research Engr.
California Inst. of Technology

Clement P. Lindner
Chief Engr., South Atlantic Div.
U.S. Corps of Engineers

Philip F. Morgan
Prof. of Sanitary Engineering
Univ. of Iowa

Ireal A. Winter
Chief of Hydraulic Machinery Br.
U.S. Bureau of Reclamation

Geo. F. Wislicenos
Chmn., Mech. Eng. Dept.
Johns Hopkins Univ.

To sit before such a group one felt a bit awed while listening for words of wisdom. One heard the banter of such experts participating in a panel discussion of "Centrifugal Pump Problems" involving current progress, new developments, advances in the field, and unsolved problems.

DEAN DAWSON, in opening the symposium, pointed out how life itself and advance of civilization depended on pumps and pumping. Starting with the heart as the first pump he outlined pumping history to the present day dependence on pumps in manufacturing and in living, as we know it today. He praised the F-M management for having fostered this gathering of pump and pumping experts in the first symposium of its kind and character.

DR. RICHARD C. FOLSOM (Univ. of Mich.), as the first speaker called this "Hydraulics Forum" a trailblazing undertaking to bring educators, experts and industry closer together in an endeavor to improve pump design, manufacture and performance.

Research he defined as—"The process of finding out something

THE AUDIENCE, composed of engineers and pump users from coast to coast and Canada to Mexico. Pres. Morse, delivering address of welcome; at table, the panel.

F-M's Smallest and Largest

President Robert H. Morse, Jr., is standing in ring of F.-M.'s largest pump manufactured to date (116-inch) requiring three flat cars for shipment. He holds F-M's smallest centrifugal, a ¾" pump presented to him as the first unit turned out by the new Kansas City plant.

about something that nobody yet knows about"—the field of tackling the unknown. Fundamental Research produces a stock-pile of ideas. Applied Research puts these ideas into use in the development of products and processes.

He said that he could foresee nothing spectacular ahead in centrifugal pump developments; but, in the nature of pump improvements the aim was toward prevention of pump damage by cavitation and other failures.

Panel on Pumps and Pumping

DR. ROBERT T. KNAPP (Cal. Tech.), as panel moderator introduced the speakers in the order following and did a splendid bit of moderating throughout.

CLEMENT P. LINDNER (U.S. Engrs.) in commenting on axial-flow large capacity drainage and flood-control pumps, said that for such low head pumps, high specific speed was the important element. In Florida, bids were being opened at the time for four such uits of 144-inch size to preclude water-logging of an 1130 sq. mile area of the Everglades. (These are the same units, referred to previously, on which F-M proved to be the low bidder.—Ed.)

These pumps along with the 116 in. pumps already supplied will keep main drainage canals low enough so that land owners can dewater their acreages by pumping into the canals during excessive precipitation periods. Mr. Lindner believes smaller pumps operating at higher and higher specific speeds are needed for greater economy. For such low head pumps, efficiencies of 70% or better is considered satisfactory. Although pump manufacturers were wary of attempting to produce such large pumps, the demand must be met.

MODERATOR KNAPP pointed out, here, that the burden of research and development of pumps (particularly large pumps) has been placed on the manufacturer alone. He intimated that such should not be the case in development of pumps for exceptional duty.

DAN R. RANKIN, (Peerless Pumps) in discussing deep well pumping, said that shaft problems were becoming more and more real with increasing depths of pump settings in deep wells. Some settings at 1000 ft. had already been made. Many 600 to 800 ft. settings had been successfuly made and 400 ft. settings had become commonplace. There had been but little changes made recently in shaft design and quality. In the deep settings, shaft stretch due to starting thrust comprised the chief problems. Next were the bearings to stand such weight and thrust load. Some roller bearings and ball bearings of 4-ft. diameter are now being used.

In referring to advances of the submersible type deep well pump he reported that considerable improvement in the submerged motor had been made—sufficient for the three leading motor manufacturers to decide to go into production of submersible motors.

In reply to a question as to why submersible pumps had been so slow of wider adoption, Mr. Rankin replied that lubrication, motor problems and especially the sand pumping problem had deterred the wider use of submersibles. His company, for one, had been slow to enter the submersible field, but with improvements over the span of 15 years since introduction, the picture had changed markedly.

PROF. HOLLANDER added that the initial cost of turbine and submersible pumps was about equal. Mechanical seals on the latter had been greatly improved but so had shaft bearings, in which sleeve bearings are replacing more costly ball bearings. In deep well turbine pumps. America has been the world leader in improvements, retarding interest in submersibles which, however, had their place.

PROF. PHILIP F. MORGAN (Univ. of Iowa), discussed the pumping of solids-liquid mixtures such as pulp and sewage sludges. Although the solids content of paper pulp and sewage sludges were about the same (5 to 6% solids) their behavior in pumping was markedly different. The friction in pipe lines by paper stock was usually 30 times that of water. In sewage sludges the variation in friction might be seven-fold. The only approach in a problem seemed to be that of a rough guess supplemented by a cut-and-try operation. Too much grit on too much grease was the principal problems in sludge pumping. Grease ring formation on pipe interiors was the chief obstacle in sludge pumping. The only practical answer seemed to be a discharge line of ample bore and simple design for cleaning out the grease ring and grit as necessary.

Dr. GEO. F. WISLICENUS (Johns

Hopkins Univ.), in discussing specialty pumping, pointed to the desirability of single stage pumps at higher and higher speeds for maximum efficiency and overall economy. The drawback was the necessity of greater perfection in design and use of materials. A 6-inch impeller at 25,000 rpm may be practical, according to his thinking. In pumping at high temperatures, he showed a color slide of a centrifugal pump glowing red while pumping some material in an atomic energy plant. Pumping at 1500°F was not too uncommon.

PROF. ALADAR HOLLANDER (Cal. Tech.), reviewed rapidly 25 years of progress in centrifugal pumps. He felt that the water in a centrifugal still knew more than we do about centrifugal pumping. The real knowledge is still missing. He referred to the very large screw-type drainage pumps designed by Wood and co-workers in 1920 for New Orleans.

In reply to a question as to the practicability of widening the efficiency range for centrifugals, PROF. HOLLANDER said that variable veins could be provided but that they are overly complicated for ordinary uses. A single impeller will give 85% upward efficiency and changing impellers seemed the most practical solution. Simplicity of design and operation is still to be sought for in pumping as in other operations.

PROF. WISLICENUS (Johns Hopkins), did not agree. He believes variable veins to be practical and deserving of more study and perfection.

From the floor the question was raised as to the most practical method of preventing pump and intake troubles from ice formation on impellers with marked loss of efficiency. There was no very satisfactory answer by the experts. Pump heating had been a failure . The best approach to preclude needle ice formation was to avoid agitation of the chilled water. At Safe Harbor, Md., live steam added ahead of the turbines had proved the most practical scheme. A surprisingly small input of steam has done the job. Only a fraction of a degree rise above 32° is required.

DEAN DAWSON'S closing words emphasized the first need in pumping as that of *reliability* and second only was the matter of refining in efficiency at the possible cost of less dependability. Of the two, reliability still stood first and foremost as a practical matter.

Problems Arising from Increasing Water Demand

As the principal luncheon speaker GAIL P. HATHAWAY, past president of the Am. Soc. of Civil Engrs., and special assistant to the Chief of Engrs., U.S. Army, spoke on "Problems Arising from Increasing Water Demands." Tracing the cycle of water from the ocean to the clouds, through precipitation and again to the ocean eventually, Mr. Hathaway pointed out that water is inexhaustible, doesn't lose value in its transformation from water to vapor and back again into the earth or stream as a demineralized product. In the U.S. average precipitation is 30 in. per year. Of this, only 8 inches return promptly to the stream as run-off, while 22 inches represents the high per cent which is absorbed or is returned to the skies through evaporation or transpiration. As to water use and abuse, Mr. Hathaway stated that in 1900 the quantity of water taken from surface supplies amounted to 600 gals./capita/day. Now some 50 years later this figure had mounted to 1100 gal./capita/day. Between 1950 and 1975 it is likely that water requirements will again double. Of the 1100 gal./capita/day present demand, 80% is used in irrigation which for the most part comes from wells. In discussing ground water depletion, Mr. Hathaway cited the case of West Texas where 30 times as much water is being removed through well pumping as is being replenished. In Arizona, usage exceeds safe yield by about 30%. On the other hand, it was pointed out that when scientifically managed, ground water sources can be made to double their yields.

As to defiling of water supply by pollution, Mr. Hathaway stated that the U.S. Public Health Service reports 22,000,000 sources of pollution (mostly industrial) is expected to cost from $9 to $12 million dollars to correct over the next 10 years.

Following the luncheon the visiting engineers proceeded to the new F-M plant to see pumps manufactured, tests and demonstrations in operation, and a comprehensive display of the many things which are manufactured and sold by Fairbanks-Morse & Co. A cocktail party and buffet supper rounded off a full and busy day.

The New F-M Kansas City Plant from the Air

The ultra-modern foundry is in the building to the rear; manufacturing, testing and sales department occupy the larger building.

Quality Control of Water From Watersheds

by **ALFRED T. NEALE,** *Assoc. Engr., and* **E. F. ELDRIDGE,** *Dir. and Chief Engr., Wash. Pollution Control Comm., Olympia, Wash.*

WATERSHEDS are the source of a great many municipal and industrial water supplies. Many of these watersheds exist today in the same condition as they did before their use by human beings. Hundreds of millions of gallons of water are used daily by communities and industries. In some cases, only the barest minimum of treatment or purification is necessary to provide a quality of water suitable for these purposes. A great many watersheds have been partially or completely logged. The cut-over lands are in various stages of regrowth, or have been converted to other economic uses. The protection of these water supply watersheds is becoming more and more important as water demands increase and as it becomes necessary to look to surface sources to supply this demand.

In the economy of some areas, the effect of watershed activities on the natural spawning and development of fish is of equal importance to the effect on water supply. The problem also involves flood control, industrial and agricultural uses, and the water rights of many small water users. The need for control exists in the upper reaches of the drainage basins, if adequate protection is to be given to the varied uses of these watershed waters.

Activities Influencing Water Quality

The continual industrial development and the rapid growth of communities demand increasingly larger quantities of high-quality water. Considerable concern is expressed by certain watershed managements regarding the problems arising from the increasing use of the watershed by the public, and especially by highways and railroads. These activities tend to affect the sanitary quality of the water, as well as its physical characteristics, such as color and turbidity.

In many cases, however, activities associated with the logging industry have by far the greatest effect on water turbidity and, in some cases, water quality. The reason for the great bulk of sediment which is carried downstream from logged watersheds is often due to improper location and construction of road systems. This is not necessarily deliberate on the part of logging companies, but is due largely to the lack of understanding of the over-all problem. Road location is often chosen without regard to water interests. Roads are built on the edge of stream channels and the overcast material is dumped in the stream. Often drainage methods are improper, culvert spacings unsatisfactory, and no attention is paid to soil stabilization.

Other logging operations which affect water quality are unsatisfactory yarding methods, and the deposition of slash and debris in channels. Soil leachings from areas which have been burned over contribute to color and sediment to some water supplies. Barriers, impassable to fish migrations, are formed by debris in channels. The barriers so formed have been known to remove large areas of spawning beds from production.

Other activities which may impair water quality from watersheds are mining, gravel operations, improper agricultural methods, grazing, and some recreational activities. Railroads, hydroelectric power and flood control projects may also contribute to the watershed problems.

It is not expected that these activities will be discontinued in order to protect the quality of waters supplied by the watersheds. This obviously is not reasonable or possible except in certain cases where the watershed is completely owned by the water user. Even in these cases, complete elimination of watershed uses is not always feasible or desirable.

Suggested Control Measures

Certain reasonable corrections, however, can be made which will afford at least partial protection of the water quality. Such corrections have been accomplished in many watersheds. Methods of logging and road construction have been altered with the result that the water supply was improved. Other cases of correction have been achieved in watersheds above fish spawning areas. Much more correction is needed, however. It is the primary purpose of this paper to suggest methods by which watersheds supplying water for fisheries, hatcheries, and other uses receive adequate protection. These suggestions are based on methods already in use, or advanced as a result of studies made of various problems. For the most part they should be considered as constituting the minimum requirements. All suggestions will not apply to any one watershed, but will need to be adapted to conditions. In some cases they may not provide adequate protection, and more detailed requirements may be desirable.

Sanitation Measures

1. Portable chemical toilets should be provided for isolated work groups, such as temporary logging camps. Effective sewage treatment and disinfection facilities should be provided for permanent and semi-permanent installations in watersheds.

2. Other temporary camps [for sheep herders, hunters and fishermen, small mining operations, and campers] should provide subsurface waste disposal facilities located at an adequate distance from flowing water.

3. On water supply watersheds, periodic inspections of sewage disposal facilities and their operation by competent personnel should be a part of the water quality protection program.

4. Additional sanitation requirements are necessary for transcontinental railways operating in one or more of the major water supply watersheds. The sanitation problem arises when, in the wintertime, sewage solids become frozen to the car undercarriage. These solids are later deposited upon the tracks and on bridges in the watershed area. They then may find their way into the watercourses by action of snowplows or by subsurface runoff. A way of correcting this problem is to install holding tanks with sufficient capacity on cars to allow for disposal to municipal sewer systems at the various railway stations and terminals.

Erosion, Turbidity and Silt

Much can be accomplished to preserve the productive values of surface waters if continued consideration is given to the erosion problem from the initial planning stages until the watershed logging operations have been completed.

This article by Messrs. Neale and Eldridge will be of interest to those engaged in the field of water supply and also to those concerned with pollution control. Watersheds seldom are entirely owned and controlled by water departments. Where ownership either is private or by state and Federal agencies, control must be supported and sometimes initiated by pollution control agencies. In addition, watershed protection involves implications beyond water supply alone.

The location both of the road network and of the various cutting areas in relation to the entire watershed should be established in advance in such a manner as to minimize the disturbances to the terrain. This practice will lessen the problems of siltation and erosion. Cutting boundaries, landings, and spur roads should be laid out with due regard to conditions of topography, soil and climate, in order to avoid disturbance to stream channels. Also, the effects of snow accumulation and melt must be taken into account to handle drainage, so that muddy water is kept out of channels.

Logging Roads

Some of the factors which should influence road location are the stability of the parent rock, soil overburden, and the texture and drainage characteristics of the soil. Roads should be located away from stream courses and long, steep gradients and excessive cuts and fills should be avoided so as to protect both the stream and the road embankment. Consideration should be given to locating roads on benches and ridges where they are less apt to adversely influence water quality and where road maintenance will be facilitated.

Certain features of road construction can adversely affect water quality unless precautionary measures are followed. Excess dirt and debris should never be deposited directly into a flowing stream, nor placed below the high water level of the channel, since it will eventually be washed downstream during subsequent flood conditions. Cut slopes should be properly graded so as to reduce the slump hazard. Large, unstable cut-and-fill slopes should be mulched and seeded in order that vegetation will become established rapidly and erosion losses will be minimized. Roads should be built only in dry weather to reduce the effects of soil disturbances and to avoid the direct introduction of muddy and silty waters to flowing streams. When necessary, road surfaces should be adequately ballasted to prevent the accumulation of muddy and turbid waters which can drain to adjacent water courses.

Road Drainage

The proper use of culverts on logging roads is an important phase of the problem to minimize stream disturbance. General recommendations for the use of culverts are as follows:

At all road crossings, culverts should be installed unless the fills are sufficiently permeable and stable to permit minor storm flows to pass through without erosion and siltation. Wherever it is possible, drainage should be routed to bench areas for settling. Drainage also should be routed below unstable areas to avoid saturation, slumping and erosion.

In placing culverts, care should be used to prevent excessive channel disturbances and to keep fill material away from culvert inlets and outlets. Culverts should be large enough to carry the greatest flow expected during a 10-year period; it is expected that different rates of flow will be noted for different areas and climates. Culverts should be set on the natural slope and extended well beyond the fill slopes.

Headwalls should be used at the ends to prevent fill erosion into the culvert, and permanent rock or a metal outlet apron should be used to disperse the flow and to prevent gullying. Large culverts should contain a series of steps or should be designed in accordance with fishery department standards in order to allow for the passage of migratory fishes in search of gravel spawning beds. Large culvert inlets should be inspected and cleaned if necessary prior to the annual rainy season so as to prevent clogging and a subsequent washing away of the entire fill.

Logging Operations

Logging methods and types of equipment used are important factors affecting the soil cover and stream channels. Unwise procedures may degrade water quality.

Recommended logging practices include the use of streams to locate cutting boundaries in order to prevent excessive disturbances to stream banks and channels. In areas subject to severe erosion, only small cutting areas should be developed in the vicinity of streams and creeks. Buffer strips at least 30 feet wide should be left along channel edges and low-value stumpage growing on steep pitches adjacent to the channel should not be logged. When logging near channels, trees should be felled uphill, and slash and debris should be kept out of water courses.

Depending on topography and soil conditions, there are many instances in which high-lead cable logging uphill is desirable from the standpoint of water quality protection. To prepare for the times when it is not possible to lift logs across channels by means of a slack line, cables should be installed as temporary measures in order to prevent disturbances to stream banks and the formation of log jams.

Tractor logging should, if possible, be limited to areas of less than 15 per cent slope where soils are heavy or highly erodible, and tractors should not be used when the ground is saturated or where the slope is over 30 per cent. Only a few turns should be brought in over each skid trail, to avoid deep gouging and channelizing. When yarding across channels with tractors, use should be made of temporary, removable log or metal culverts.

Skid trails should be drained at short intervals, especially during the rainy season, in order to divert water away from landings. The use of catch basins or the diversion of drainage to flat areas below landings is often desirable to prevent silt and mud from directly entering streams and rivers. It is imperative that skid trails should not be run in channels or down channel banks.

During and after logging, small slash should be thrown into skid trails and scattered on landings, thus providing a mulch to reduce erosion. This small slash also provides shade to encourage rapid re-establishment of plant cover to hold the soil. In many instances it is desirable to seed bare areas of disturbed soil with grasses and legumes to provide a quick cover crop.

It is imperative that cross drains or water bars be installed in the steeper, abandoned skid trails and spur roads to prevent high drainage concentrations and severe erosion. Dispersed waters should be either spread to allow a filtering action or conducted to flat areas for settling before reaching flowing creeks and streams.

Many of the basic features presented under logging road construction also apply to other road and railroad construction, including State and

county highways. Consideration should be given to the soil types encountered in the watershed. Precautions should be taken to minimize the ground disturbance. Satisfactory and adequate methods should be employed for the control of erosion and for the prevention of sedimentation and turbidity in the streams of the watershed.

Flood Control Projects

Dams and flood control projects should be considered a part of the watershed program since they usually are undertakings of considerable size which may degrade the quality and productivity of natural waters. Variable-level outlets are necessary at these structures in order to minimize unsatisfactory temperature and turbidity conditions downstream from the dam.

To prevent wave erosion and turbidity, cover crops may be desirable on the flowage areas of reservoirs where water levels may fluctuate widely. Areas subject to submergence up to 3 or 4 months should be seeded with reed canary grass. Areas subject to submergence up to 2 or 3 weeks should be seeded with meadow foxtail or smooth bromegrass.

Mining access roads should be constructed in accordance with the provisions recommended for logging roads so as to prevent the development of erosion and conditions of siltation and turbidity. Sluicer-type mines, process mines, coal and gravel washing operations should provide for adequate settling of tailings prior to their discharge to a watercourse. Toxic wastes, if present, should be treated in accordance with the pollution control authority recommendations.

Grazing Operations

Grazing can be completely prohibited on domestic water supply watersheds where the municipality owns or controls the entire watershed. On other watersheds, it should be controlled by fencing, patrol, salt distribution, and seasonal regulation. A grazing management plan should be set up for any watershed where this use is of importance. The plan should include an inventory of the grazing resource by ownership, and a record of grazing use. Type and numbers of stock intensity of grazing and entrance and exit time are important factors. The plan should also include such sanitary control features as location of stock driveways and bedding grounds, and a patrol to remove dead animals. Stock watering should be accomplished by troughs located away from the stream bed.

Periodic inspections should be made to determine the effects of grazing on soil conditions and erosion. In the event stream crossings are necessary, they should be accomplished in a minimum length of time. Where inspection shows that the presence of large numbers of big game animals are factors in overgrazing, soil trampling and compaction, and erosion, consideration should be given to effective population control measures.

Recreational uses should generally be restricted or very carefully regulated on water supply watersheds, since large numbers of people on a watershed can create problems of pollution and sanitation as well as a fire hazard. On many water supply watersheds, a permit system of entry is used, with the entrant being given a copy of rules and regulations pertaining to the watershed. Rules and regulations should be posted on all watershed boundaries.

Agricultural Problems

Recommendations of the Federal Soil Conservation Service should be strictly followed, in order to prevent erosion of farm lands and the resulting turbidity and siltation of the receiving waters. Return flows from irrigation have in several instances created problems of turbidity, sedimentation, and increased chemical content which affect water quality and bacterial pollution. The first requirements are to use all of the water applied and to control the rate of flow to reduce erosion through more efficient irrigation. Further study is needed before recommendations for the full solution to the problem can be made.

Sawmill Operations

Sawmills located in close proximity to any waterway should take the following precautions in the disposal of waste sawdust, bark, slabs, and trimmings:

1. At the mill site, wastes should be kept above the high water mark, and out of any adjacent waterway in a place where they will not be washed into the water later.

2. If debris is to be burned, a properly constructed burner must be used. The burner should be located far enough away from the water so that unburned waste will not escape into the water way either on the ground or through the air.

3. Chutes which cross a waterway should be constructed in such a manner that the wastes will not fall from the chute to the waterway.

4. Burned-out screens and sections should be patched or repaired immediately.

5. Chutes carrying wastes to a burner under forced draft should be deflected downward, or should be passed through a hopper or a series of baffles, so that the fine sawdust will tend to settle to the fire and will not be carried out the screen.

6. Sawmills which truck sawdust and slabs away from the mill site should have these wastes dumped away from waterways, and in no case should sawdust and slabs be dumped below the high water mark of the waterway, or in such a position that they will later wash or leach into the waterway.

When log ponds are located near watercourses, they should be so located that only a portion of the stream flows through the pond. The overflow should be regulated in such a way that the amount of sawdust, chips and suspended matter that reaches the waterway is reduced to a minimum. Log ponds should be cleaned by dragging or dredging, rather than by flushing into a stream or river.

Summary

The increasing demand for water of high quality to supply municipal and industrial needs is directing attention to activities within the watersheds from which these supplies are taken. Activities such as logging, road construction, farming, and recreation in watersheds can be so controlled as to give a significant degree of protection to the waters. Suggestions have been made for such control programs.

Bathtubs Not Plumbing According to Iowa Law

A bathtub isn't plumbing in Sioux City, Iowa. According to a press report, Municipal Judge Barry J. Sisk ruled that Walter E. Larsen, 61, who installed a bathtub himself, was innocent of violating a city plumbing ordinance.

The judge cited the Iowa legal code's definition of plumbing as "any receptacle or appliance installed or used to receive waste water, house soil, slop or sewage."

He ruled that "a bathtub actually doesn't receive waste water, but clean water, even though that water which may be discharged from the bathtub is waste water."

Maine Water Utilities Meeting

Host is Town of Norway, first in state to flouridate water supply

A Report by **J. ELLIOTT HALE**, *Supt., Kenebec Water District, Waterville, Maine*

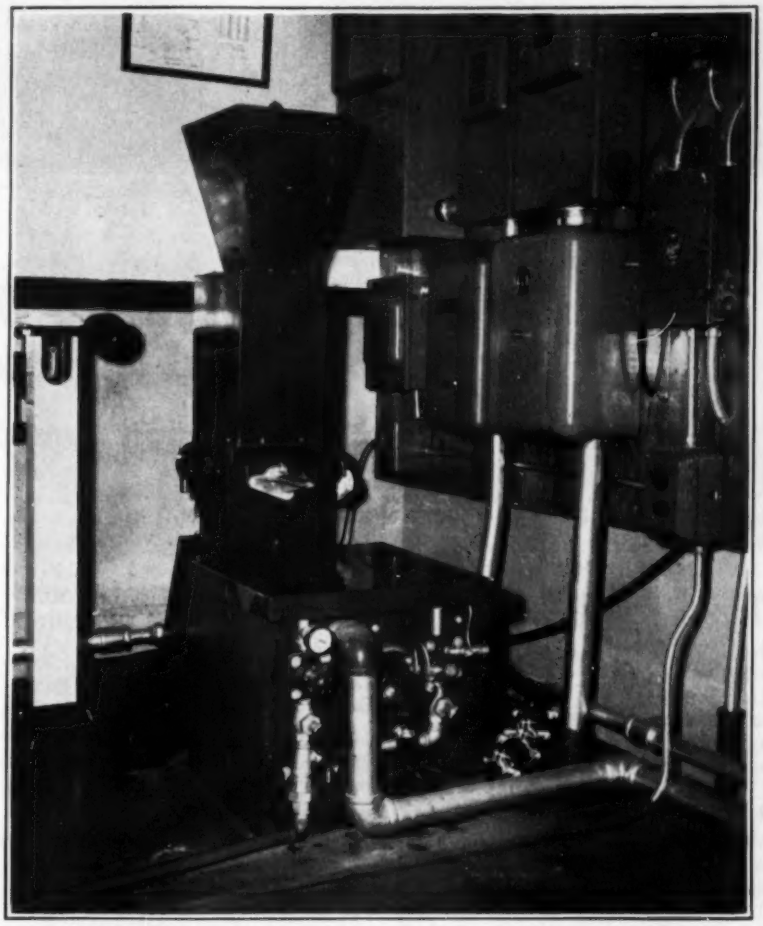
THE Spring meeting of the Maine Water Utilities Association was held at Norway, Maine, where the local Water District was host to 133 members and guests on April 14. High point of the meeting was the visit to the District's pumping station on the shore of Lake Penneseewassee, to inspect the new fluoridation and pumping equipment.

A. G. BLACQUIERE, Water Supt., presented a brief history of the District. The District was formed in 1941, to take over the properties of the old Norway Water Company which had been in existence since 1885. As the purchase price could not be agreed upon, the case was taken before appraisers. Hearings were held at Portland and the appraisers decided that the sum of $110,856.00 was fair and just.

After the system was acquired by the District, it was found that many improvements were necessary. A bond issue of $145,000 was approved by the Maine Public Utilities Commission.

The improvements consisted of new mains to reinforce the grid system; extensions to take in new services; and replacement of small mains with larger sizes to give better service and to provide better fire protection. Several sections of mains, leading from the pumping station to the center of town and to the reservoir, were cleaned. This was done in order to provide capacity for more water from a new 1,200 gpm centrifugal electric pump recently installed in the pumping station. Water consumption ranges from a normal 300,000 gpd to a maximum 1,080,000 gpd. The maximum amount is used during a dry summer and when the corn shop is in operation. There are about 10 miles of pipe in the system, 54 hydrants, and 20 sprinkler systems. The District has about 1,047 customers.

In March of 1951 the *townspeople* voted to instruct the Trustees of the Water District to apply fluorides to the water supply. Nothing was done by the Trustees until on May 19, 1952, the *voters* of the *District* voted to use fluorides, and to accept a donation of $1,500 from the Town to help defray the expenses of setting up the unit.

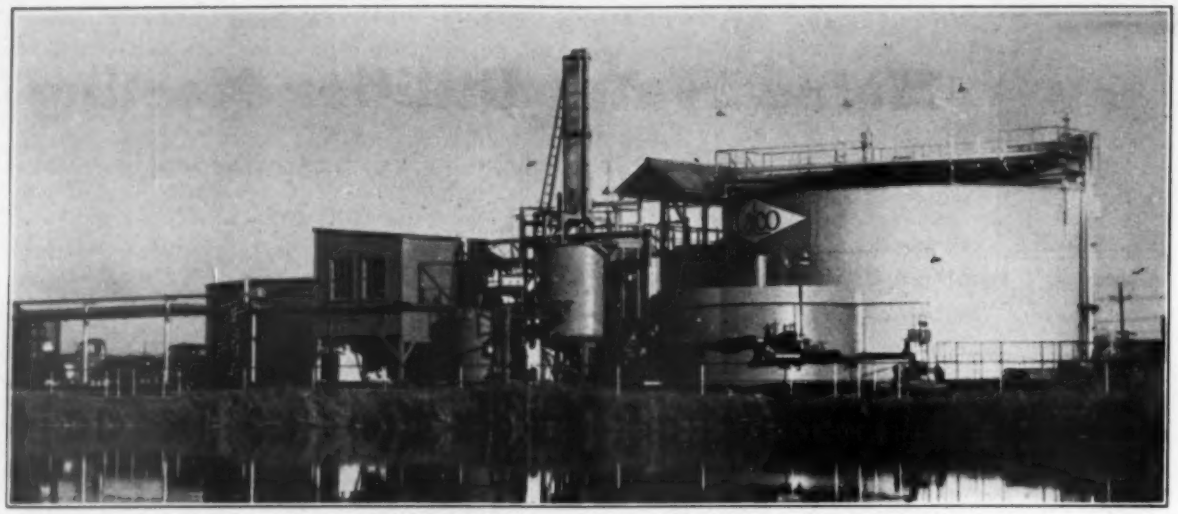


PIONEER fluoridation installation in Maine, at the Town of Norway Water District. The W & T volumetric dry feeder applies sodium silico-fluoride.

A permit was secured from the State Bureau of Health to apply sodium silico-fluoride. A volumetric chemical feeder (W & T type N. A.) was installed at a total cost of $1,388.34. The total cost of operation for the year ending December 31, 1953, was $329.74, or approximately 11 cents per capita.

No complaints have been received from any customer of the District since the inception of the fluoridation treatment.

Mr. Gerald H. Lamprey of B.I.F. Industries, Providence, R.I., gave a very complete and informative paper titled "A Review of Practical Fluoridation." He discussed State Board of Health regulations, fluoride chemicals available, the cost of chemicals, and various types of feeding equipment. He elaborated upon the operation of some fluoridation units, their limits and application, and concluded his talk with a review of analytical methods.



PILOT PLANT trickling filter installation at American Cyanamid Co., Bound Brook, N.J.

Treating Organic Wastes on Experimental Trickling Filters

I. Fundamental Design Considerations

by **JOHN F. VOGLER**, *Sanitary Engr., American Cyanamid Co., Bound Brook, N.J.*

THE basic methods for domestic sewage treatment are time tested, have proved reliable, and are relatively economical. With certain modifications in design and capacity, these established methods are very often successful in treating organic industrial wastes.

Trickling filters are used to biologically oxidize and coagulate many different types of organic industrial wastes. They have been particularly successful in the treatment of food processing, fermentation, tannery and textile effluents. In the chemical industry, trickling filters have been the preferred method of treatment for wastes from antibiotic manufacture. Among examples of these installations are the treatment plants of Upjohn at Kalamazoo, Mich., Merck at Elkton, Va., and American Cyanamid at Pearl River, N. Y., and Willow Island, W. Va.

It is less generally known that biological trickling filters are capable of oxidizing certain organic chemical wastes, especially those containing simpler compounds such as phenols, acetic acid, and fomaldehyde. Specific examples of such plants are those of Dow at Midland, Mich., Hercules at Mansfield, Mass., and American Viscose Company at Meadville, Penna.

Laboratory and Pilot Studies Determine Treatability

Theoretically, all organic compounds composed of carbon and hydrogen can be oxidized to carbon dioxide and water; and those containing nitrogen, sulfur or halogens can be oxidized to the corresponding nitrate, sulfate or halide. Of course, no single treatment method is applicable to all organic effluents. Some compounds are not attacked biologically, and others must be subjected to more or less drastic primary treatment to prepare them for biological treatment.

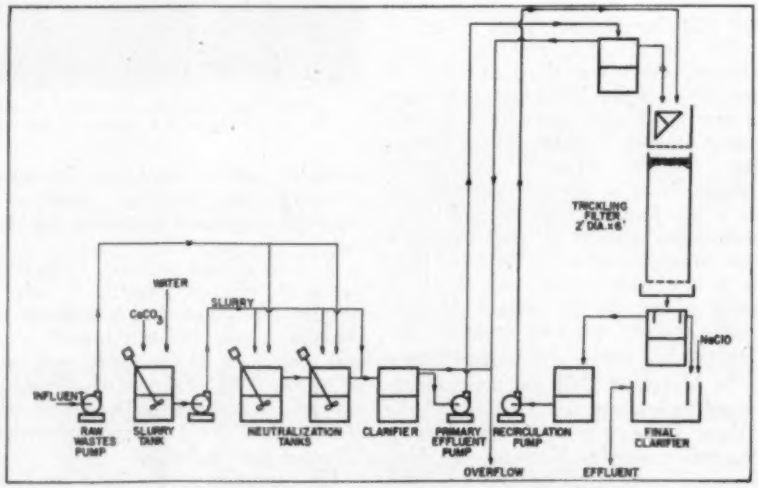


Fig. 1—DIAGRAM of the small pilot plant at Bound Brook

Trickling Filters that Teamwork Built

Organic chemical wastes constitute a special and difficult problem in the correction of stream pollution. Of all devices now available for the treatment of these wastes, the trickling filter is the most popular. It is simple, rugged, withstands considerable abuse, and is relatively economical. In spite of these advantages, the trickling filter sometimes fails miserably when it is operated without adequate consideration of what actually is needed. Those responsible for the selection of waste treatment processes should recognize that these devices generally function successfully only when the design is based on experimental evidence.

Several steps leading from the consideration of using a trickling filter for treatment of a specific industrial waste, to the construction and operation of a workable plant, will be outlined in this series of four articles by a team of young Cyanamid engineers. Each individual handled one phase of the experimental work in a plant of the American Cyanamid Co. at Pearl River, N. Y. (Lederle Laboratories), or at Bound Brook, N. J. (formerly Calco, but now Organic Chemicals Division).

The results reported in these articles provide a good example of how teamwork within an organization is stressed by modern industry. Great importance is placed on the ability of people to work together; at times this quality is considered as important as the technical ability of the individuals involved.

In addition, competent supervision of experimental work is essential to its success. The stream pollution control work at Pearl River is under the direction of James M. Brown, Sanitary Engineer, who is active in the affairs of the New York Sewage and Industrial Wastes Association. The Organic Chemicals Division work is under the direction of L. L. Hedgepeth, consultant to the Organic Chemicals Division of the American Cyanamid Company. Mr. Hedgepeth, as Editorial Associate of *Water & Sewage Works*, is well known to the readers of this publication.

* * *

The four papers discussing the topic "Experimental Trickling Filters for Treating Organic Wastes" were presented at the 1954 Southern Industrial Washes Conference in Houston, Texas, and are here published with the permission of the Conference.

Because of the variable nature of organic chemical effluents, which are characteristic of differing products, processes and plants, a thorough investigation is necessary to determine the feasibility and reliability of treatment by biological trickling filters. Usually the investigation takes the form of a laboratory study followed by a period of pilot plant operation.

A laboratory study is necessary to obtain preliminary information on the direction to pursue, and to determine the methods of treatment which have promise. Such a study establishes the feasibility of treatment, provides preliminary data for designing a pilot unit, and reduces pilot plant operating time; often it serves to indicate the type of units required and the operating variables to be included in the pilot plant. Frequently this study is merely a series of "batch" experiments. Occasionally, qualitative, not quantitative, data are sought. The study may be done on the plant site or may be "farmed" out to laboratories specializing in this work; such as universities or consulting engineers.

Although "glassware" studies in the laboratory usually will establish whether a treatment method is worthy of further investigation in a pilot plant, the results obtained cannot be applied to full-scale plant design. This is because of the difficulty in maintaining continuous flows in small laboratory units, problems of space, sample storage and transportation, and most important, the engineering unsoundness of extrapolating laboratory results to full size installations.

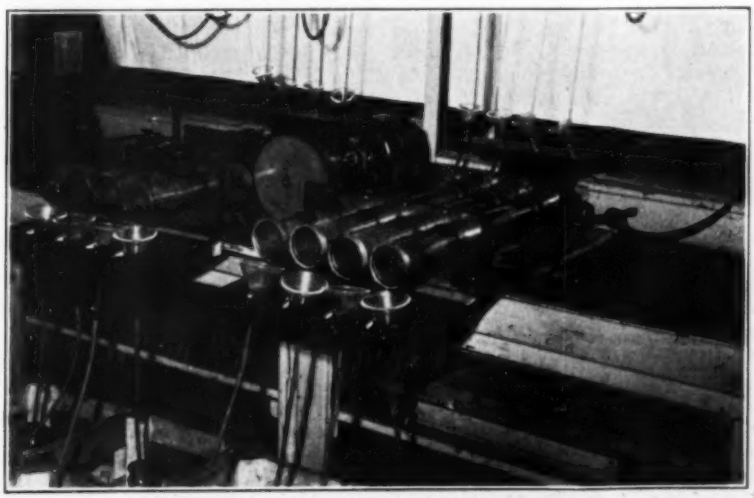


Fig. 2—EXPERIMENTAL trickling filters devised by Renn use plastic tubes

Determining What to Design in a Pilot Plant

The functions of a pilot plant are first, to reduce the "ignorance" factor in existing knowledge; second, to obtain assurance of successful year-round operation under all conditions; and third, to obtain firm data for design of the plant most economical to build and operate. A pilot plant usually will pay for itself many times over by providing precise information regarding "how-much", thus avoiding reliance on convention, conservatism, engineering dogma, or abnormal safety factors.

A pilot plant has been described as "the place where the mistakes, mishaps, inefficiency, wastage, spoilage and confusion occur in the testing of a new process." It is better for such things to be learned in a small experimental unit than in a full-size plant under full load. In addition, pilot plants often are useful tools when a full-size plant has been built and is in operation. In pilot plants, operating variables and methods of operation

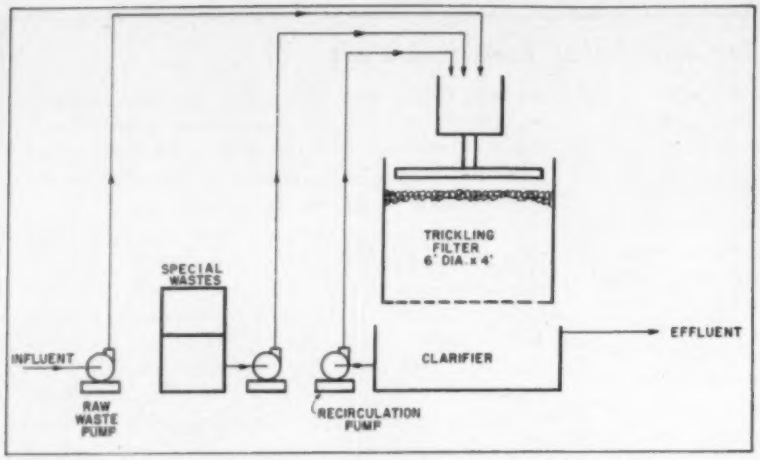


Fig. 3—PEARL RIVER, N.Y., 1949 pilot plant in schematic diagram

Fig. 4—PILOT FILTER at Pearl River provided preliminary design data.

can be more readily investigated than they can be in a full-scale plant. This is especially true in the organic chemical industry where manufacturing processes are continually changing and, as a result, the waste characteristics also change.

A pilot plant should be so designed that the processes and capacities duplicate those anticipated in the prototype. The preliminary laboratory study will be of great assistance in this phase of the design. Sizes of pilot units may be governed somewhat by preliminary studies, but they should be large enough to provide reliable data consistent with ease of operation, and with economy of construction and operation. Usually economics and availability of equipment governs the size of units used. Often much of the pilot plant can be constructed of factory surplus equipment, affecting great economy. The really important thing is to design into the unit all the variables, flexibility and facilities for measurement and sampling that are likely to be needed to secure data for design of the full-scale plant. The importance of flexibility in the design cannot be overemphasized. Since the pilot plant is an experimental unit, it should be possible to make changes with relative ease.

The author is familiar with the construction of pilot plants that have been built with practically no preliminary office design. The units were thrown together in the field with what equipment could be obtained at the time, the "design" being engineered by actual direction of the workers on the spot and by hurriedly prepared sketches. Under such conditions it is truly remarkable how fast and how economically a plant can be thrown together when time is of first importance. Nevertheless, a more orderly procedure of pilot plant design has a greater chance of being successful.

Cyanamid's Experience

The Experiment Station of the Mass. Dept. of Public Health at Lawrence, Mass., made preliminary studies on the treatability of wastes from the Bound Brook plant of American Cyanamid Co. First, the problem was "roughed out" in glassware. Then it was studied in small trickling filters of a simple but effective design. These consisted of 4-in. and 6-in. diam. stainless steel pipes 6 ft. in height, filled with stone 0.5-in. to 2.0-in. in diameter. Recirculation of liquor was accomplished by adding the raw waste in a small tank that received the filter effluent, and pumping the mixture to the top of the filter. The flow was maintained by adjustable orifices. The operation of these experimental filters showed that the wastes were amenable to biological treatment, and they provided data for the design of a pilot plant to determine quantitative data.

Pilot Plant Construction

A schematic diagram of the Bound Brook pilot plant, designed as the next step, is shown in Fig. 1. This pilot plant included units for neutralization, aeration, chlorination, primary and secondary sedimentation, trickling filtration and recirculation. The trickling filter was 2 ft. in diameter by 6 ft. deep, and was dosed by means of a tipping bucket distributor and a perforated plate. The filter shell, of #10 gauge sheet metal, was fitted with intermediate sampling connections at the 2 ft. and 4 ft. depths. Filter media was crushed stone, 1½ to 3-in. in size. The filter unit loading range was from 0.5 to 10 lb. of B.O.D. per cu. yd. The hydraulic flow range was from 1/64 to 3 gpm, corresponding to 3 to 58 mgad.

It will be noted that the liberal use of steel drums for the reaction, holding and settling tanks allowed considerable economy in constructing the plant. This pilot plant was operated for 15 months at Bound Brook and provided invaluable data on the treatability of the extremely complex organic chemical waste. The results proved not only that the wastes could be treated by trickling filtration, but that preliminary iron removal was necessary to prevent clogging of the filter by iron bacteria.

Laboratory Trickling Filter

A novel type of laboratory experimental trickling filter is that developed by Renn* as illustrated in Fig. 2. This unit consists of sets of plastic tubes 2 ft. long and 2 in. in diameter, rotated by an electric motor through a gear reducer. Raw wastes are fed into one end of the tubes from overhead feed carboys either by a metering pump or by a gravity siphon. The tubes are on a slight horizontal tilt, causing all waste applied to contact the entire interior surface of a tube before draining from the lower end. Operation of this type of unit has been correlated with large size filters and has proved extremely useful for qualitative and semi-quantitative data.

This experimental equipment is compact and the active biological growth is readily accessible. The units are quickly activated and do not clog. An eight-tube unit, with all pumps and accessories, can be transported in the trunk of an automobile. One of these tube units operated at a rate of 7 liters per day has a flow-through-equivalent of 8 mgd. applied to a 6-ft. bed of 2-in. stone.

Cyanamid Co. has made use of this laboratory type of unit at several plants, and now has one in operation in conjunction with the large pilot plant at Bound Brook. Merck Co. has made similar use of this type of equipment. The Pearl River Plant of Cyanamid Co. is presently installing a unit.

Simple Type of Pilot Plant

Fig. 3 illustrates the simple and inexpensive type of pilot filter plant, 6-ft. in diameter and 4-ft. deep, used at our Pearl River Plant. The plant cost less than $1,000 to construct. It consisted of a raw waste pump, recirculation pump, high rate trickling filter, reaction driven distributor, and effluent collection tank.

The unit operated for several months, and the data obtained formed the basis for design of the high rate trickling filter plant illustrated in Fig. 4. The flow rate was about 6 gpm and the recirculation rate varied from 1:1 to 8:1. The filter media used was 2½-in. trap rock, enclosed in a 3/16-in. steel shell. The distributor of this unit later was fitted with a motor drive, to give uniform distribution at very low flows.

Complete and Flexible Plant

Details of a very complete and flexible pilot plant are shown in Fig. 5. The plant was built in order to learn how to efficiently operate and intelligently expand the existing large industrial waste treatment facilities at the Cyanamid Co. Pearl River plant. It was designed to provide information on the effect of these trickling filter variables: loadings, recirculation rates, recirculation methods, natural and forced ventilation, temperatures and enclosures. Fig. 6 illustrates this type of plant as constructed at Pearl River.

The Pearl River installation includes raw and recirculation pumps, two high rate filters with motor-driven distributors, collection pans, clarifiers, flow meters and automatic sampling devices. Each trickling filter is 6 ft. in diam. and 4 ft. deep, consisting of a 3/16-in. steel shell filled with rock. The stone rests directly on 4-in. by 4-in. timbers spaced 1⅜-in. apart. The filter effluent falls into a collection pan and drains into clarifiers located directly beneath the filters. One filter unit is enclosed in a building for comparing the operation of open and enclosed filters. Forced air diffusers are embedded in the enclosed filter unit. The entire bottom of the open filter is sheathed in sheet metal in order to check the effect of forced ventilation on filter operation. Compressed air to supply the enclosed filter is supplied by a blower at the waste treatment plant, while a 1200 cfm Varidrive centrifugal blower provides air for the open filter.

This plant was designed for treating a flow of 10 gpm, and is so flexible that at least eleven flow-pattern combinations of parallel and of series operation and recirculation are possible.

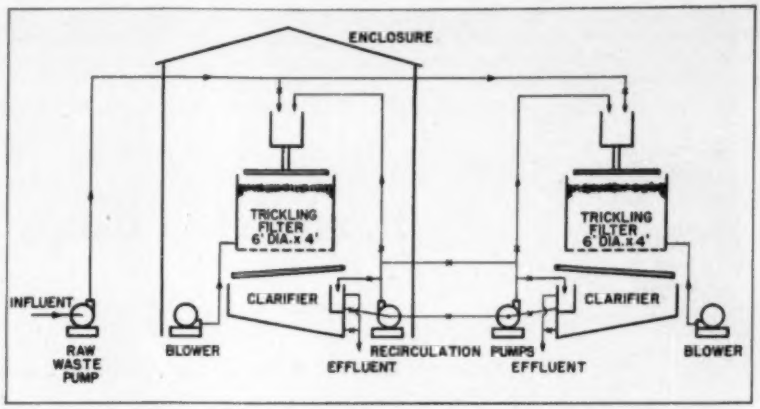


Fig. 5—PEARL RIVER, N.Y., 1952 pilot plant in schematic diagram

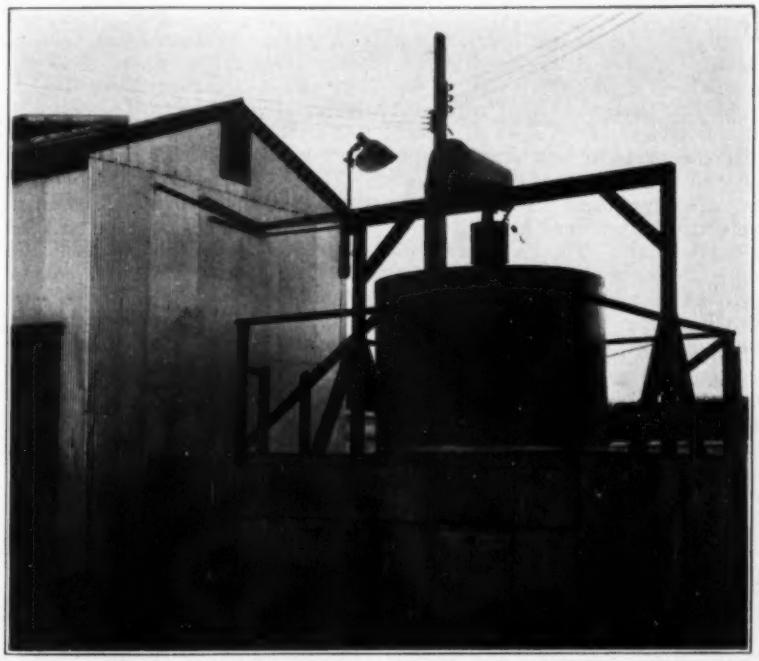


Fig. 6—ENCLOSED and open pilot filters at Pearl River for detailed studies

*Gloyna, E. F., Comstock, R. F., and Renn, C. E. "Rotary Tubes as Experimental Trickling Filters." Sewage and Ind. Wastes, 24: 1355, 1952.

A small activated sludge pilot plant, located in the rear of the filter units, provides additional flow combinations and treatment variations.

The trickling filter pilot plant was designed by Alfred B. Cherry (Part III of this series), and the activated sludge unit by Louis A. Tucci, (Part IV of this series).

The experimental units described have been operating for over two years and are providing excellent guidance for making decisions on the treatment of wastes from a growing and changing plant.

II. Pilot Plant Design Considerations

by **GEORGE E. HENDEE, JR.,** *Design Engr., American Cyanamid Co., Bound Brook, N.J.*

PRELIMINARY considerations relating to the treatment of organic chemical wastes from American Cyanamid Company's Bound Brook plant have been described in Part I of this series. Mr. Vogler explained that the problem was first roughly assayed in glassware at the Lawrence Sewage Experiment Station, then was qualitatively examined in small stainless steel units. The Lawrence data were subsequently confirmed in a small and flexible pilot plant at Bound Brook, using a two-foot diameter trickling filter.

Since the results of all three of these preliminary steps were favorable, it was decided to develop design data for contemplated complete trickling filter treatment to dispose of 15 to 20 mgd of waste waters from this organic chemical manufacturing plant. The author, as engineer assigned to the Power and Utilities Department of the manufacturing plant, was given the design responsibility. Construction of this large pilot plant was completed, and it was placed in operation during the summer of 1953.

Selection of Equipment

In approaching this problem, one must answer the question: "For what purpose is the large pilot plant trickling filter to be designed?" There are at least two reasons for designing the unit. First, to provide up-to-date information on the treatment behavior of the wastes; and second, to critically evaluate a prototype for the much larger final plant to treat the entire effluent.

In the first of these two requirements, there was considerable latitude in the selection of equipment. Homemade equipment or make-shift items might have been used to good advantage to solve the problem, but to do so would fail to provide good data for design of the full-scale plant.

Therefore, it was decided to employ conventional treatment units, so arranged that the desired flexibility was attained, in order that the resulting information would be directly translatable into the selection of equipment for the full-scale plant.

The design engineer was given, by the staff sanitary engineer, basic data which fixed the size, type and arrangement of the components. These data included B.O.D., pH, volume, total and dissolved solids, and the presence of sludge-forming dissolved substances, such as aluminum, iron and manganese. The sanitary engineer also indicated the detention times required for neutralization, primary and secondary clarification, and specified the material to be used for pH correction. These specifications had been worked out in the laboratory and by previous sub-pilot plant operation. The design problem then became one of evaluating economics, efficiency, ease of operation and simplicity of maintenance.

Economy and Efficiency Factors

Economics usually dictates the use of commercially available equipment wherever possible. This simplifies initial construction of the pilot plant because, in most cases, manufacturers of such units can supply pilot size units as well as larger models of widely varying capacities. Further, data obtained from operation of these smaller units will be more nearly valid for full-size equipment of the same type. It was obvious that the cost of standard equipment will be substantially less than units specially designed and custom built. Further, the purchase and use of a manufacturer's equipment enfranchises the purchaser to use that manufacturer's patented system of treatment. This point was

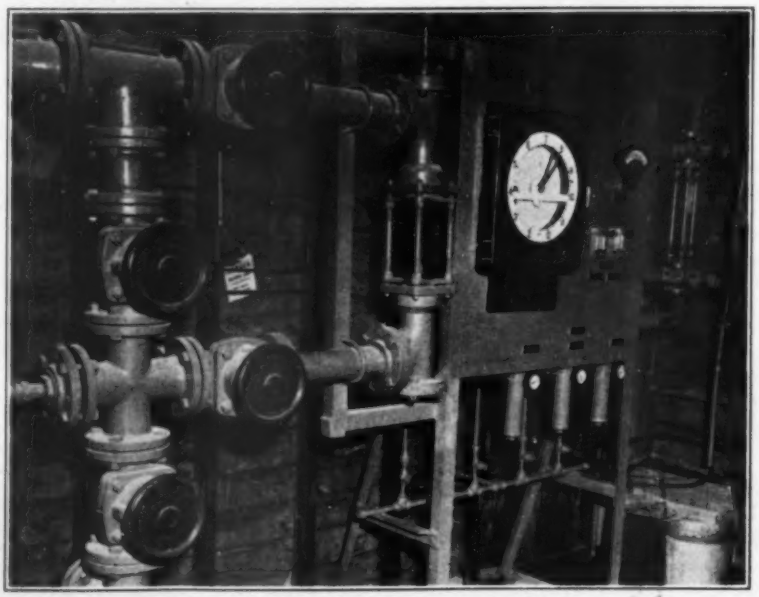


Fig. 7—BOUND BROOK, N.J., pilot plant control panel

carefully evaluated before making a final selection of equipment. Other design goals, such as ease of operation and simplicity of maintenance, are apt to be more inherent characteristics of commercial equipment than of custom or home-made units.

In the design of a pilot plant, flexibility should be the keynote. It should be possible to vary influent and recirculation rates, retention time, chemical concentrations, air volume, etc., and to be able to measure these quantities at will.

Retention time in the neutralizing unit is regulated by an automatic level controller, which can be set to maintain the liquid volume at any desired percentage of the total retention time. The volume of the unit, which determines the maximum desired retention time, is a basic factor of the plant design. There are adjustments for the rate and volume of sludge removal built into most commercial sludge contact clarifiers; units of this type usually would be provided following neutralization.

Fig. 8—TRICKLING FILTER and clarifier units in the Bound Brook pilot plant In background, left, is dried lime slurry pit.

Degasification and Aeration

Because substantial quantities of ferrous iron and carbon dioxide were known to be present in the effluent to be treated, it was considered that degasification to remove CO_2 and aeration to oxidize the ferrous iron were essential steps. A very satisfactory means of degasifying and oxidizing ferrous iron is provided by a wood degasifying tower, resembling a small cooling tower. In this unit, the influent enters the top of the tower and trickles over splash plates, flowing countercurrent to forced air introduced at the bottom.

When the ferrous iron content of the waste is especially high, the growth of iron bacteria may cause an excessive amount of slime to build up on the horizontal splash plates and impede the liquid flow. This condition can be overcome by modifying the construction of the splash plates, to eliminate any ledges upon which bacterial sludge can settle.

Should a degasifying tower prove unsatisfactory, there are submerged type aerators that can be used, in conjunction with or prior to neutralization, to sweep out CO_2 and to oxidize ferrous iron. Aerators of this type are served by pressure blowers instead of static fans which are used on the degasifying tower.

The relative economics of these two systems is a matter for individual plant consideration. In the use of a tower, the liquid must be pumped to the top, but the fan or blower horsepower requirement is quite small. In the case of submerged diffusers, the pumping horsepower requirement is low, but the pressure blower horsepower is high. The physical arrangement of the plant and the topography of the ground on which the plant is built will enter into the economic study.

Assuming a continuous influent to the head end of the plant, the pump that moves the liquid to the degasifier (or to the sludge contact clarifier if submerged diffusers are used) can be operated by the liquid level control in the neutralizing unit through a pneumatic pinch valve on the pump discharge.

Flexibility in distributing liquid over the stone filter can be achieved by the use of a four-arm unit, in which two arms are used for low flows and four arms operate at high rates. This unit prevents excessive gushing and excessive turning speed at high flows, and still provides sufficient propulsion force at low flows to keep the distributor turning.

No particular flexibility is required in the secondary clarifier, other than variability in the rate of sludge removal by the sludge pump. The removal of sludge may be continuous or intermittent, as required by the amount of sludge.

Measurement of Flow

The provision of flow volume indicating equipment is essential. In a pilot plant, it is not required that these flow instruments be recording; recording instruments may be necessary or desirable in a municipal plant. A flow totalizer or integrator is of particular value in a consolidated community sewage treatment plant, so that each user can be fairly charged for his share of the treatment. Some form of automatic testing device also might be required to determine chlorine demand or other special charges required at the community plant.

In a pilot plant, it is imperative to provide a flow meter for the influent and another for the recirculation line, and additional meters at points where the control of pumped volumes must be coordinated. If the topography of the site is such that use can be made of gravity flow, it should by all means be done.

Measurement of influent flow, together with laboratory test data, enables one to determine the loading on the plant; measurement of the recirculation, also with laboratory data, will yield information on the total filter loading.

Laboratory Data Are Needed

In a pilot plant, provision for sampling should be made at every point from which a sample could conceivably we useful. As a check list, the following points are enumerated: raw waste, effluent from neutralization, following aeration, following the sludge blanket clarifier, at one or more points through the depth of the stone filter, effluent from the filter, and the secondary clarifier effluent. Laboratory data derived from these samples will guide the entire progress of the pilot plant investigation.

A time limit should be placed on the operation of a pilot plant for industrial waste treatment. One never can

Fig. 9—GENERAL VIEW of units in the Bound Brook pilot plant
This illustrates gravity flow (right to left) from degasifier to primary clarifier, to filter, and to final clarifier.

learn all the answers to questions that are promulgated by operating such a plant. The plant should be operated through its breaking-in period, and then through all four seasons of a year; the object being to gather enough data to conclusively prove that operation of a full-scale plant is feasible, and to determine how the full-scale plant should be designed. The large plant can then be designed with frozen specifications. Continued operation of the pilot plant is in the realm of academic interest, insofar as the designing engineer is concerned.

Automatic control devices should be incorporated in the design to permit more-or-less unattended operations around the clock. Automatic pH control is essential in treating wastes containing free mineral acidity and free caustic. It would be highly desirable to provide a recording controller, so that records of operations can be consulted at a later date. Closely associated with automatic pH control would be automatic lime slurry production. This can be accomplished by the use of an automatic dry lime feeder, a makeup water flow meter, a level controller and a solenoid in the makeup water line.

The control panel at the Bound Brook pilot plant is illustrated in Fig. 7. At the center can be seen the influent flow meter. To the left of the flow meter is a series of by-pass control valves which permit the flow meter glass to be cleaned without interrupting the plant operation. To the right of the flow meter can be seen the automatic pH recorder-controller. Next on the right are two small purge flow meters installed to insure cleanliness of the stilling wells of the lime and neutralizing unit level controllers. Above these meters is a thermometer to measure the temperature of the influent. On the far right is located the flow meter for makeup water to the lime slurry unit.

When the pH controller calls for slurry, the pneumatic valve opens, admitting lime to the neutralization tub; the slurry level drops, the makeup water solenoid valve opens, and the dry lime feeder starts. Since the ratio of makeup water and dry lime feed has been previously set to produce the concentration of slurry required, the supply unit is filled until the level controller shuts off the makeup operation.

If gravity flow from one operation to another cannot be used, it may be necessary to include sumps with float switches to control pumps that move liquid from one operation to another. Without these sumps, it would be almost impossible to manually coordinate a series of pumps with reference to flow meters and to have the plant operate smoothly and with continuity.

Thermometers will supply information of value in correlating results. These can be used to measure the temperature of raw waste, effluent following neutralization, liquor in the filter bed, and filter effluent. These instruments also will certainly give data relating results to seasonal conditions.

Physical orientation of pilot plant final plant units is closely related to economics. The use of gravity to transfer liquid from one unit to another cannot be overstressed. A gently sloping hillside is an ideal location, because the influent end of the plant can be placed high on the hill and the effluent end can be at a lower elevation. For relatively small pilot plants, the influent units can be raised on high dunnage, and the effluent units set flush in the ground.

The head photograph of Part I in this series illustrates the physical arrangement of the Bound Brook pilot plant. The small wooden building in the center is the control house. Beneath this house is the lime slurry unit which is fed by gravity from the dry lime feeder above and inside the control room. To the right is the neutralizing unit. From this unit, the neutralized effluent is pumped to the top of the degasifying tower which is located on top of the sludge blanket clarifier. As can be seen, the clarifier unit is raised on wooden dunnage so that its discharge can flow by gravity onto the trickling filter (the unit visible directly below the "Calco" diamond design painted on the large tank). To the right of the stone filter, and set flush with the ground level, is the secondary clarifier into which the effluent from the trickling filter flows by gravity.

The surface of the stone filter and of the secondary clarifier are illustrated in Fig. 8. The physical layout of this location allows the effluent from this clarifier to flow off by gravity. Just visible, between the clarifier and the wooden building, is the pump that removes sludge from the clarifier. This gravity flow arrangement lessens the number of pumps required and the complications of coordinating their operation.

All units should be located close together. This practice reduces the length of connecting piping, piping costs, pump horsepower and friction losses. It also simplifies operation, sampling and recording temperatures.

In selecting the proper size of equipment, the factors of greatest importance are the B.O.D. and sludge values of the waste to be treated. The B.O.D. value establishes the rate of input to the plant, and determines the proper filter loading in pounds per acre foot or per cubic yard of stone. The influent pump size and trickling filter size are based on the same information. Similarly, sludge-handling equipment size can be established from the preliminary solids data.

Retention time required for aeration and neutralization, related to the raw influent volume, determines the size of the units for these operations. The sludge-blanket clarifier size can then be set by the operating rate in gallons per square foot specified by the manufacturer of the unit selected. The size of the secondary clarifier is calculated on the basis of effluent gallons per square foot, or by the retention time desired. Whatever rate of recirculation is used, the final clarifier will discharge only an amount equal to the raw influent to the plant; only what comes in can go out. The rate of recirculation required will influence the selection of distributor arms for the trickling filter, and may increase the required size of the filter.

Some discussion of the materials of construction should be included. A pilot plant is, by nature, temporary construction. Eventually it will be removed. The demolition of masses of monolithic reinforced concrete is no mean task. The suggestion is made that units normally installed as concrete tanks should be constructed as steel-plate tanks; this applies particularly to clarifiers and trickling filters.

For handling highly acid raw wastes, there are several resistant piping materials: stainless steel, Karbate, Saran-lined steel, Haveg, etc. Economy favors plastic-lined steel pipe for these temporary uses. The raw influent pump may well be the standard acid-resisting bronze formulation offered by several pump manufacturers.

The raw effluent pump is located adjacent to the compositing basin at Bound Brook. Since the pH of this effluent is about 2 to 2.5 the pump suction leg is of stainless steel. The pump is of chemical bronze construction with a totally enclosed fan-cooled motor.

The vertical pipe from the pump is a plastic-lined steel discharge line that carries the influent to the pilot plant. There is an alternate plastic-lined suction line that reaches out 150 feet into the Bound Brook settling lagoon. At this point the effluent has been neutralized to pH 4.5 to 5 and has been partially settled. These two points of effluent pickup were installed to further increase the flexibility of the pilot plant.

The neutralization and lime slurry units can, to advantage, be of wood, as can the degasifying tower. After neutralization, ordinary black steel pipe and iron body valves and pumps can well be used.

The use of poured concrete for the trickling filter foundation, including the effluent channel, appears unavoidable. Heavy wood timbers can be used for dunnage with no foundations or footings at all if the load-bearing quality of the soil is sufficiently good. If the soil is not good enough, some form of footing will have to be provided.

Fig. 9 shows in composite many of the points previously mentioned. The photograph illustrates the use of gravity flow from degasifier to clarifier, clarifier to filter, and filter to secondary clarifier. It shows the small size of the degasifier blower, the sampling points for influent to the filter and halfway through the filter, and the temperature indicator for the filter influent. The operator is recording the temperature of the filter effluent. The four-arm distributor operating at low flow and the steel plate construction of the clarifiers and the filter are also obvious.

The photograph also illustrates several operating platforms. These platforms have been constructed at all points in the plant where it is expedient to have an operator.

1954 Convention of F.S. & I.W.A. Should be Record Breaker

To Be Held in Cincinnati, Ohio, Oct. 11-14

Arrangements for the 27th Annual Meeting of the Federation of Sewage and Industrial Wastes Associations, to be held at Cincinnati, Ohio, October 11-14, 1954, are virtually complete. The Ohio Sewage and Industrial Wastes Treatment Conference is acting as host to the Federation at the Cincinnati meeting, which is expected to draw one of the largest registrations on record. Many of the final details have already been completed by the Local Arrangements Committee, under the general chairmanship of Arthur D. Caster, Sewage Disposal Engineer for the City of Cincinnati.

The technical program, developed by the Federation's Publications Committee under the chairmanship of F. W. Gilcreas, is designed to appeal to the maximum number of Federation members with their diverse interests. Among the program arrangement features will be a return to concurrent sessions of the perennially popular forums for operators and industrial wastes personnel, intended to provide program time for interesting inspection trips to Cincinnati's new Little Miami sewage treatment plant and the new Sanitary Engineering Center of the USPHS; also, inclusion of an additional half-day session to accommodate more industrial wastes papers. In addition, a demonstration of safety in sewage and waste treatment will be given by a well-qualified committee.

Technical Papers

Papers to be presented will deal with pollution control in the Ohio River valley; the solution of Cincinnati waste problems; new developments in sludge digestion, thickening, and filtration; aeration problems; process and equipment patents; infiltration specifications and tests; application of biological treatment processes to industrial wastes; petrochemical wastes; soluble oil treatment and recovery; ion exchange resins in wastes treatment; sewage works design criteria; electric power reliability requirements; and the effects of thermal factors on oxygen balance in a stream.

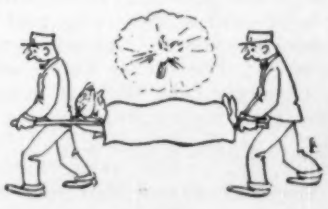
The Manufacturers' Exhibit promises to be of its usual high caliber in coverage and quality, as also does the social program.

Headquarters for the meeting will be the Netherland Plaza Hotel. Requests for hotel accommodations should be sent directly to that hotel.

Sol Seid is N.J.S. & I. W. A. Federation Representative

In our report on the Thirty-Ninth Annual meeting of the New Jersey Sewage and Industrial Wastes Assn., published in the May issue, we listed Henry Van Der Vleit as the newly elected Federation representative of the association.

Actually, Sol Seid, supervisor of Public Works, New Brunswick, N.J., was elected at that meeting to serve a three-year term as Federation representative. Mr. Van Der Vleit has just completed his term as representative. Mr. Seid is Past President of the New Jersey association.



Joint Committee on Bathing Places
1953 Progress Report

THE last printed report of the Joint Committee, published by the American Public Health Association in 1949, was titled "Recommended Practice for Design, Equipment and Operation of Swimming Pools and Other Public Bathing Places." Under date of May 1, 1952, the Association published a small 4-page reprint entitled "Changes to Recommended Practice for the Design, Equipment and Operation of Swimming Pools and Other Public Bathing Places, as Published by the American Public Health Association in 1949." This supplementary report is now inserted in new copies of the printed pamphlet which is sold by the Association for 55c. When a new edition of the pamphlet is printed, the changes will be made in the pamphlet.

The Joint Committee presented a progress report to the Engineering Section of the Association at its 1953 annual meeting. Two subjects discussed in the report relate particularly to the field of water supply and sewage treatment. The editors of *Water and Sewage Works* consider the information presented of sufficient importance to warrant the publication of these sections of the report in full.

Bathing Water Quality Related to Health

One of the members of this committee (A. H. Stevenson) has furnished to the committee an abstract from a survey of studies of bathing water quality and health as carried out by the United States Public Health Service. In view of the extent and thoroughness of these studies which are especially informative because of the dearth of information on the subject, the committee as part of this report presents below the quoted abstract in full:

"In an attempt to determine the relationship between natural bathing water quality and its effect on the health of the bather, a series of three field studies were conducted by the Environmental Health Center of the Public Health Service in cooperation with State and local health agencies. The specific objectives of these studies were: to determine what frequency of swimming might be expected from the population groups chosen; to determine what relative increase in illness incidence might be expected from swimming in even the cleanest waters; and to determine what differences in illness incidence might be expected from swimming in waters containing various degrees of bacterial pollution.

"The three studies of bathing waters and population groups in different geographical locations were designed so that factual data might be secured for the use of health administrators in determining what quality of natural bathing water would be acceptable to them in view of local conditions in individual states and areas. It should be noted that in these studies consideration was not given to the less tangible but nonetheless beneficial aspects of outdoor swimming, such as fresh air, mental relaxation, moderate amounts of sunshine, physical exercise, etc. The studies were conducted on 1. a Great Lake, namely Lake Michigan at Chicago, Illinois; 2. an inland river, namely the Ohio River at Dayton, Kentucky, using a nearby swimming pool for comparative illness studies; and 3. a tidal water, namely Long Island Sound, at New Rochelle and Mamaroneck, New York.

Methods of Study

"The general methods used in each of the three studies were similar. Two bathing areas were selected on the basis that: a) bacterial water quality was substantially different and subject to moderate but not rapid fluctuations; and b) adjacent resident population groups were of similar socio-economic status and contained 1500 or more families who would generally be expected to use the selected beaches for bathing purposes. In carrying out each of the studies over a period of approximately two months, calendar record forms were maintained by voluntary individual family participants who kept a record of daily swimming and illness experiences, based on familial diagnoses, for each individual member of the family. The illnesses recorded were eye, ear, nose, and throat ailments, gastro-intestinal disturbances, and skin irritations. Water quality determinations were made at the selected bathing beaches on a schedule which would cover anticipated fluctuations due to local conditions.

"Upon completion of the field and laboratory aspects of the studies, statistical analysis of the results was made by two or more of the three methods: 1) observation of the prevalence and incidence of illness in each area as related to swimming experience and average water quality over the entire period; 2) selection of periods of significant poor bathing water quality and relatively good quality, followed by analysis of the swimming experiences and illness incurred during these periods and for the days immediately following them; 3) observation of the number of people having an onset of illness a specified number of days after swimming and the comparative water quality on the day when swimming occurred.

Results and Conclusions

"The median range of bathing water quality covered in the three studies was 90 to 2700 coliform MPN per 100 ml. Maximum coliform levels were as high as 460,000 MPN per 100 ml. Participation in each of the three studies ranged from 5,000 to 10,000 individuals. The number of person-days of useable record for individual bathing areas selected varied from 138,000 to 300,000. The overall percentage person-days of swimming varied from 4.5 to 10.7 for the different studies. The number of illnesses of all types recorded per 1,000 person-days varied from 5.3 to 8.8 for the different study areas.

"The three studies have furnished valuable information on the swimming experience of individuals in various age groups and localities. Generally the 'under 10 year old' age group did 20% to 40% and the 'under 20 year old' age group 60% to 75% of the total swimming. The studies have demonstrated that an appreciably higher illness incidence may be expected in the swimming group over that in the non-swimming group regardless of the bathing water quality. They have shown some 100 per cent higher illness incidence in the group under 10 years of age than for those over 10 years of age. They have shown that in studies of this type, eye, ear, nose, and throat ailments may be expected to represent more than half of the overall illness incidence, gastro-intestinal disturbances up to one fifth, and skin irritations and other illnesses the balance.

"Specific correlation between illness incidence and bathing in waters of a particular bacterial quality were ob-

served in two instances. First in the Chicago Study, a comparison was made between swimmers on days when the bathing water quality was relatively 'good' or 'poor'. A significant increase in illness incidence was observed among swimmers who used the South Beach on three selected days when the water had an average coliform content of 2300 per 100 ml. The observation, based upon a significance test against the hypothesis that 'high' pollution causes an increase in illness incidence, is one which could occur as a result of chance but once in one hundred trials. This evidence should not be taken as conclusive. There were only three days on each side of the comparison and this did not permit a complete analysis of the effect that weather might have had on the result. When the weather is hot many more people go swimming, some being people who swim only on very hot days. It is possible that such people have a characteristically higher or lower rate of illness than those who swim more regularly. However, the evidence is of interest and does provide a warning signal.

"The second instance of positive correlation was observed in the Ohio River Study where it was shown that, despite the relatively low incidence of gastro-intestinal disturbances, river swimming in water having a median coliform density of 2700 MPN per 100 ml. appears to have caused a significant increase in such illnesses among these swimmers. Incidentally, the gastro-intestinal illness rate for this group was substantially higher than that observed for any other group in any of the three studies.

"Admitting the difficulties of conducting studies in which nature rather than man controls many of the variables, sufficient evidence is available to indicate that some of the strictest bacterial quality requirements for natural bathing water now existent might be relaxed without significant detrimental effect on the health of the bathers. This always has been and will continue to be a matter of judgment."

The committee points to the great need for further studies of bathing water quality and further attempts to evaluate the relationships of such quality to the public health. Critical evaluation of the persistence and pathogenic organisms or closely related non-pathogens in bathing water would be helpful together with studies of methodology for most practical means for their destruction. Also, critical evaluation of the relative public health significance of bathing place problems should be made, including showers, foot baths, floor disinfectants, etc.

High-Free Residual Chlorine in Swimming Pool Water

In England, advantages have been found in the maintenance of relatively high concentrations of free available chlorine (1.0 ppm or above) with accompanying high alkalinity, in disinfection of swimming pools. Recent studies in the U.S. are of interest. Following is an abstract from papers presented before the Division of Water, Sewage and Sanitation Chemistry, American Chemical Society, on September 16, 1952, by Mood and Robinton, and the Middle States Public Health Association Meeting on April 14, 1953, by Mood, as summarized by Mood.

"High-free residual chlorination of swimming pool water is the term used to describe the recently developed practice of treating water with chlorine or hypochlorite in sufficient dosages to create and maintain a free available residual chlorine concentration equal to or greater than 1.0 ppm. It is the application of the principles of breakpoint and super-chlorination of public water supplies with modifications. Its development was stimulated by the need for a procedure of applying chlorine to swimming pool water, particularly in pools located out-of-doors, in such quantities that at all times when the pool is in use the residual chlorine concentrations would be capable of maintaining bacterial densities below prescribed limits and yet not be irritating to the eyes of swimmers. The name of the process is a differential term and identifies this practice as being separate from the heretofore accepted procedures of maintaining concentrations of residual chlorine in water less than 1.0 ppm.

In principle, high-free residual chlorination is the process of adding large dosages (5-20 ppm) of chlorine or hypochlorite to an alkaline water (pH=8.0-8.9). This procedure permits the ammonia that is present in the water to break down to nitrogen instead of forming chloramines. Also, if any chloramines are formed they would be mono-chloramines principally, with little or no chance for the formation of nitrogen trichloride. High-free residual chlorine is not irritating to the eyes of the swimmers as has been demonstrated in a study by Campbell of the swimming pool water at Smith College where this practice of water treatment has been used continuously since December 1950. Instead, this and other studies have demonstrated that less irritation of the eves of swimmers is encountered when the swimming pool water is treated with high-free residual chlorination than when it is treated with the conventional amounts of chlorine. One-half to two-thirds less irritation of the eyes of swimmers is reported when the free residual chlorine values are between 2.0 ppm and 4.0 ppm and the pH 8.0-8.9, as compared with water with less than 0.60 ppm free residual chlorine and pH of 7.0-7.5. The benefits of high-free residual chlorination have been recognized by the British, and the Ministry of Health recommends this procedure for the treatment of swimming pool water under the name of breakpoint chlorination.

"Studies were carried out at an indoor pool at Smith College, Northampton, Massachusetts, and at an outdoor pool at Hartford, Connecticut. Following were conclusions reached as to the bactericidal accomplishments:

"1. High-free residual chlorination of swimming pool water produces bacteriological results within the maximum limit recommended by the Joint Committee Report for the number of bacteria per 1.0 ml.

"2. High-free residual chlorination is effective in maintaining a low bacteria count in both indoor and outdoor swimming pools.

"3. High-free residual chlorination is superior to lower rates of chlorination for bactericidal treatment of swimming pool water.

"4. Several common bacteria in small numbers are capable of surviving high-free residual chlorination for at least a limited time.

"5. High-free residual chlorination is capable of keeping swimming pool water free of coliform bacteria while used by bathers."

In an article shortly to be published Mood draws the following additional conclusions concerning the relationship of irritation of the eyes of swimmers and the use of high-free residual chlorination, and the clarity of the treated pool water:

"1. High-free residual chlorination of swimming pool water reduces the amount of irritation to the eyes of swimmers when compared with marginal chlorination.

"2. Optimum conditions of the swimming pool which causes minimal amounts of irritation to the eys of swimmers are found when the pH of the water is 8.0-8.9 and the residual chlorine level is 1.00-3.99 ppm with the principal portion of the fraction as free residual chlorine.

"3. Observations indicated that the degree of clarity of the water treated with high-free residual chlorination was striking. The combination of low bacterial densities, the absence of algae and the presence at all times of high concentrations of free residual chlorine, causes the water to remain crystal clear. The water in the pool is light blue in color without any tint of green. Asthetically, the pools treated with high-free residual chlorine have been very appealing to the swimmers."

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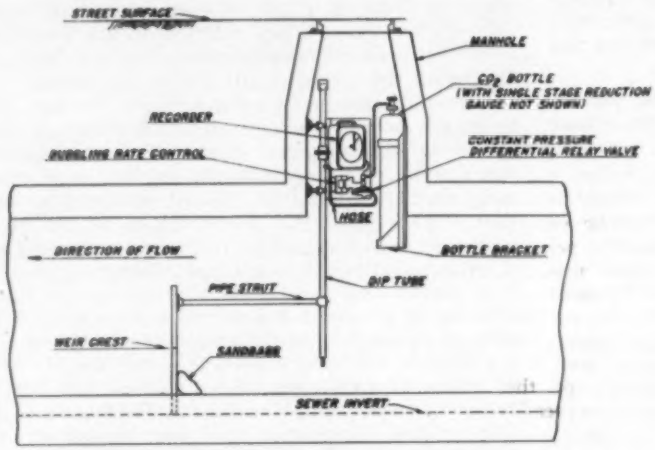
Albert H. Stevenson

Advisor from the Laboratory Section, A.P.H.A., Professor W. L. Mallmann

Advisor from the Epidemiology Section, A.P.H.A., Dr. Ralph E. Wheeler



New Instrument Simplifies Measurement of Dry Weather Flow in Sewers

The time required to make dry weather sewage flow measurements has been reduced by a new instrument.

As illustrated in the accompanying diagram, the basic parts of the instrument are a tank of CO_2 gas, a recorder, and a dip tube that is inserted in a dam impounding water from the sewage flow. In operation, the gas is passed from the cylinder, through the recorder, and then to the dip tube where it escapes. As the water level of the dam rises or falls there is a corresponding change in the rate at which the gas escapes from the dip tube. These changes are registered by a stylus on a calibrated chart in the recorder, so as to be readable directly in terms of the increase or decrease in the sewage flow.

A team of engineers from General Industries, Inc., Philadelphia, Pa., designed the new instrument. The need for the new process developed while General Industries was engaged on an original contract for the design of three of approximately 70 new intercepting chambers required by the city. In designing the chambers it was necessary to measure the dry weather flow of sewage, for which the firm first used a method incorporating the use of a current meter.

Difficulties encountered under the standard method, however, were numerous. Lethal gases present in the sewers were an ever present danger, sometimes forcing the men to wear gas masks. A further difficulty encountered with the current meter was that the meter sometimes became clogged with sewage particles especially when the measurements were made in the vicinity of tanneries. If that happened the measurements had to be halted and started all over again because the process had to continue uninterrupted for a representative period. When another contract was received to make readings for 40 additional chambers it was felt that a more efficient and accurate method was needed.

City engineers approved the idea of trying to find a better measuring process, and Fischer & Porter, of Hatboro, Pa., agreed to build an instrument to General Industries' specifications and requirements.

All component parts of the new instrument are installed in the manhole beneath the surface of the street. No permanent barricades are required because the manholes need not be opened except for a brief period when the instrument is installed and when readings are made. Also, since the measurements are recorded automatically by the stylus, it is necessary to check the operation only once every 24 hours, as compared with manually making measurements every hour under the old method. From the standpoint of economy the new method permits two men to do a measuring job previously requiring six men working in two-man shifts.

Main Extension Costs Down 33% Since 1953

Experience in at least some localities is that costs of making water main extensions are about 33% lower at present than was the case a year ago. One such case is that of Madison, Wisc., wherein the Water Department reports that a contract has recently been let to the low bidder amongst ten contractor-bidders for 5 miles of new main at cost of $24,395. Last year the contract cost for a like main in size and length was $36,335. The difference of $11,940 represents a drop of roughly 33% in the cost of main extensions between 1953 and 1954.

The Madison experience may be an exceptional one, and it would be interesting if more such exact comparisons of main extension costs between 1953 and 1954 were available to see what the experience has been elsewhere. It would appear that with money available to water departments at such low rates at present contractor bidding what it is, now is an opportune time for making main extensions or main replacements.

Financing Sewage Treatment

State authorities and consulting engineers should consider minimum needs in planning treatment works

by **ARNDT J. DUVALL**, *Municipal Engineer, Toltz, King and Day, Inc., St. Paul, Minn.*

THE construction, operation and maintenance of sewage treatment works involve practices and problems of relatively recent development. Prior to 1930 the number of sewage plants in the U.S. was small, and very few plants were in operation in Minnesota. The drought in the early 1930's causing low stream flows resulted in nuisance conditions serious enough to be apparent to the average citizen. He became aware of the fact that streams were polluted by sewage, because he could smell it with his own nose, and see it with his eyes. He did not have to be concerned with scientific data he did not understand. In addition, the made-work program of the Federal Government made it possible to construct sewage treatment works with only a part of the funds being raised locally. Prices were also down.

It is, therefore, apparent that in the 1930's sewage treatment works were constructed in many communities because of four very important factors:

(1) Realization of the need by the average citizen.
(2) The need for public construction to provide employment.
(3) Low construction costs.
(4) Federal grants toward construction costs.

As a result of the program carried out, the decade from 1930 to 1940 saw the solution of the most serious pollution problems existing at that time. An exception, however, was the pollution problem caused by industrial wastes not discharged to municipal sewage treatment works.

Conditions Change

From 1941 to 1945, World War II practically stopped all sewage works construction. As soon as the war was over, prices rose rapidly to about twice prewar costs, and some three times those of the early thirties. In addition, higher stream flows resulted in better river conditions. High employment levels and wages, and a need for private construction to catch up on housing shortages, industrial and commercial expansion, etc., pushed public construction into the background. Schools were needed much more urgently than sewage treatment plants, so tax money was voted for this purpose, as the average citizen could more readily see the need for schools, and the benefit derived. Also because of the popularity of aviation and the readily available Federal and State funds in the form of grants, considerable total funds have been expended on airport construction.

> *"Of all projects needed by the public today, sewage treatment works are far down the list of John Q. Public."*

Thus, changing conditions in the 1940's pushed sewage treatment into the background in the public's mind. It is the author's considered judgment that of all projects needed by the public today, sewage treatment works are far down the list of John Q. Public. The four factors favorable to their construction in 1930-40 are now all absent. The question naturally arises: how are public officials to finance needed sewage treatment works?

The solution of this financing problem will require the most careful consideration and close cooperation of State authorities, consulting engineers, equipment manufacturers, sewage works operators, local public officials, and all others concerned.

The writer believes that the State authorities and the consulting engineers together should make absolutely sure that treatment works proposed are essential and are the absolute minimum necessary to protect the public. This must be done to reduce costs, and to convince the people that the project is a necessity. Don't let us spend large sums of money to protect a few fish in a stream where fishing probably was never much good anyway, and other good fishing streams or lakes are available nearby. Let us not require a high degree of treatment in a situation where existing data fail to make a good case for such a high degree of treatment. Why not use stage construction, putting in a minimum now? Factors favorable to financing and constructing in the 1930's may come again. I am sure that a minimum of treatment is asked in most cases, and regulatory bodies are to be commended for following such a procedure. I am not so sure that some consulting engineers have done as well. I am afraid that some engineers try to make the job as large as possible in order to build up the fees. They ask the State Board of Health how much treatment will be required. Naturally the State Agency asks for the maximum, and then the engineer goes ahead on this basis without further discussion in an effort to put in a realistic plant. As a result, the costs are high and more often than not, no plant is constructed.

Methods of Financing

Having determined the minimum treatment works needed, and its cost of construction, maintenance and operation, how shall it be financed? Twenty years ago the construction would have been financed with general obligation bonds, authorized by a bond election, and retired with general tax levies. Operation and maintenance would have been financed by a general tax levy or by a sewer service charge.

More recently, the trend has been toward the use of the sewer service charge to pay off the bonds as well as for operation and maintenance costs. In other words, sewage works have been put on a utility basis, the same as water works, and the light and power utility. This is the most logical

Mr. Duvall's article is based on a paper presented by the author before the Central States Sewage and Industrial Wastes Assn.

"To charge a user of a sewage treatment works on the basis of his real estate taxes is as foolish as it would be to base the same user's electric light and power bill on his real estate tax."

method of financing the sewage treatment works. Of course, the financing of other parts of the sewage works, such as laterals, trunk sewers, etc., by front foot and area assessments against the benefited property owners is a different matter. To charge the user of a sewage treatment works on the basis of the amount of his real estate taxes is as foolish as it would be to base the same user's electric light and power bill on his real estate tax.

In order to finance a sewage treatment works, city officials must know the construction, operation, and maintenance costs. One index, immediately available locally, is the water works records. In many cases the annual revenue needed for the sewage treatment works will approximate that of the water works; one exception is the small community, where the charges for sewage treatment works will probably run higher.

Procedures Required

The procedure required to finance a sewage treatment works is:

(1) The council, through its city attorney and city engineer, should determine the present need for the sewage treatment works by consultation with the state authorities.

(2) Being fully convinced in their own minds that the project is necessary, they should have a preliminary engineering report prepared; this report to make recommendations and construction cost estimates for the project, as well as estimates of the cost of operation and maintenance. This report can be prepared by the city engineer, in the event he is competent to do so and has the time and the staff necessary, or by a consulting engineer, or jointly by the two. In some cases where the project involves additions to an existing plant, the Plant Chief Engineer may make the report.

(3) Having this report, its approval by the Water Pollution Authorities should be requested to determine their position relative to the recommendation made.

(4) The proposed method of financing should now be determined. The engineering report will have the cost figures necessary.

Let us assume that the project construction cost is $500,000, and that 20 year bonds at 2 per cent interest can be obtained. The annual fixed charges will then be 5 per cent per year for retirement of the principal, plus an average interest rate of 1 per cent per year on the whole amount. This totals 6 per cent, or $30,000.

Let us further assume that the engineer has estimated $15,000 as the annual operation and maintenance cost. The total funds needed annually is the sum of the fixed charges ($30,000) plus the operation and maintenance costs ($15,000) or $45,000.

Assuming all the money is to be raised by a service charge, the rate structure must be set up to obtain $45,000 as a minimum. If possible, the rate structure should be on the high side. Should more revenue than needed be collected, some of the bonds can be made callable, and paid off early. In some cases, where the revenue has been on the high side, a month of service charges has not been billed. Frequently, no matter what rate is set up, a certain amount of objection will be raised. It is much easier to make a sewage service rate somewhat high before the plant is started than to increase it later.

Service Charges

In setting up the service charge, the method of collection should be kept in mind. In most cases, it can be billed with the water charges, since the sewer service charge is usually based on water use and no meter readings need be made other than those for water charges. Therefore, if a rate structure similar to that for water can be used, billing will be simplified. Should it work out that the same rates as for water will raise the needed revenue, the answer is simple.

In setting up a service charge, it should be remembered that a compromise must be made between exactness of charge, and practical methods of charging and collecting. This is particularly true where a greater charge is made per unit of volume for strong wastes. A good method is to set up a basic charge for sewages with a 6-day B.O.D. up to 500 ppm., on top of this add a charge of say 50 per cent for B.O.D. strengths 500 to 1000 ppm., and a 100 per cent additional charge for strengths of B.O.D. from 1000 to 1500. For B.O.D. concentrations above 1500 ppm. B.O.D. the case can be handled by a special rate. Generally, all but a very few cases will fall within the 500 ppm. B.O.D. limit.

Factors To Be Considered

A detailed analysis of the water records of a community should be made, to determine the sewer service charges necessary to retire bonds and pay interest, and to operate and maintain the plant. In analyzing these records, a number of important factors must be considered. Several are as follows:

(a) Water used by the home owner for sprinkling, etc., does not return to the sanitary sewer. Water use in the winter quarter should be the basis for the year-round sewage service charge.

(b) Cooling water, and other water used but not contaminated should go to a storm sewer. The owner will not pay to separate cooling and other clean waters as long as he pays no sewer service charge. He will do this as soon as a service charge goes into effect. This factor should be taken into account in setting up rates.

(c) Creameries and other food processing industries using a lot of water will cut their wastes to a fraction of the original amount as soon as service charges go into effect. They will reduce their water use by careful supervision, separating clean wastes, and putting in water saving equipment. Revenues from a creamery should not be based on water use, or waste measurements prior to installation of treatment works and a service charge. (In one case, a creamery reduced its wastes discharged to the sanitary sewers by 75 per cent, by separating cooling wastes, etc.)

(d) Some industries, such as food canning plants operating on a seasonal basis, may be better off by treating their own wastes. The engineer's recommendations should be discussed with the industry. The writer be-

"The solution of this financing problem is going to take the most careful consideration and close cooperation of state authorities, consulting engineers, equipment manufacturers, sewage works operators, local public officials, and all others concerned."

lieves that, based on past experience, large industries will, in most cases, be better off by treating their own wastes to ultimately get the most economical results. This is true where the industrial wastes may be a large part of the total waste of the community. This would not be apt to be true in a very large city.

(e) Private water supply sources, with waste discharge to sewers must be accounted for. Meters can be placed on the private water supply, and read for sewer service charges only.

Having set up a tentative service charge rate schedule, the necessary legal steps must be taken to raise the money for construction. Depending on the legal aspects, and the considered judgment of the council, a bond election may or may not be called. General obligation bonds are voted on in many cases, in order to get more favorable interest rates, and to get the wishes of the people. Many councils, while themselves convinced of the project's necessity, do not feel they should proceed without a vote.

Minnesota Experience

Many small communities in Minnesota have sanitary sewer systems today because of their municipal liquor store revenue. In 1951, 349 municipalities with a total population of 444,664 reported a net income of $5,707,223.00. Of this amount, $4,512,271 was contributed to local government funds, largely for public improvements. This net income was equal to almost $13.00 per capita. The amount contributed to the local government was about $10.00 per capita. It is thus evident that a town of 1,000 persons having a municipal liquor store could pay about $10,000 per year on public improvements. At a bond interest of 3 per cent and 20 year bonds, this would finance a $150,000 improvement. This means that such a town could easily finance a sewage treatment plant.

Several small communities in Minnesota have a sanitary sewer system today because the municipal liquor store profits are paying for the sewage.

In three small towns, the sewage treatment plant cost was as great as that for the sewer system.

Generally, all that is necessary to dedicate these funds to a sewage treatment plant is to have a vote of the people on the question of do they or do they not wish to dedicate these funds for that purpose. Lateral sewers are usually financed by assessment against the benefited property. Since municipal ownership of liquor stores does not exist in most states this method of financing is of course not generally available.

"It is much easier to make a sewage service rate somewhat high before a plant is started, than to increase it later."

Other Minnesota towns have municipal power plants, which generally show substantial income to the community; still others buy power wholesale from a power company, and distribute the power, at a profit. In these cases, the utilities are often combined for financing purposes, and revenue bonds sold pledging the faith and credit of all the utilities for any one improvement. A lower interest rate usually results. Also, as a policy matter, the income of one utility may be greater than needed, and the excess applied to cut the sewer service charge. This is not to be recommended except where local conditions may make it advisable.

A number of Minnesota towns have adopted sewer service ordinances, and are collecting charges even though they do not have a plant, and may not construct one for several years. They are building up a fund for use at the time construction occurs. They also use this fund for operation and maintenance of the sanitary sewer system, and in some cases for lift station construction.

The City of Rochester, Minn., passed an ordinance setting up sewer service charges prior to the bond issue vote, and award of contracts. They had some $250,000 in the sewer fund from sewer service charges at the time the plant went into operation. At Rochester, a detailed report on sewer service charges, and other methods of financing the project, was prepared by Prof. George Schroepfer, in cooperation with our office. Recently, in checking, with the City Engineer and Prof. Schroepfer, the actual receipts with those anticipated, there was remarkably close agreement, a credit to Prof. Schroepfer's excellent study and report on this matter.

Bond Elections

When a bond election is held it should be well publicized. Newspaper articles, outlining the method of bond retirement, should be published in language each taxpayer can understand. Tell him why the project is needed and what it will cost him per year, either in taxes, rental charges, or in a combination of both. Remember, it will cost him money no matter what the method of collection is called.

Public meetings of luncheon clubs, chambers of commerce, etc., are valuable contacts. Generally, if the business and professional men, and the labor unions back a project, it will pass. Be sure to give the public the facts before voting.

Having the financing method approved by the voters, or the council, if no vote is taken, the next step is to have an engineer prepare plans and specifications, take bids, sell bonds, award contracts, and construct. Then place the plant in operation. *Be sure to get a competent and well-trained operator.*

The writer has not gone into the details of methods of financing sewage treatment works. Much data exists in the literature. Highly recommended information is the reprint from the Spring 1951 issue of the Ohio State Law Journal, "Fundamental Considerations in Rates and Rate Structures for Water and Sewage Works." This is a joint report of committees of the Amer. Soc. of Civ. Engrs. and the Section of Municipal Law of the Amer. Bar Assn., and representatives of the Amer. Water Works Assn., National Assn. of Railroad and Utilities Comm., Municipal Finance Officers Assn., Federation of Sewage and Industrial Water Assn., Amer. Pub. Wks., Assn., and Industrial Bankers Assn. of America.

In conclusion, it should be emphasized that financing of sewage treatment works is the most difficult of all public projects. This fact emphasizes the importance of establishing the necessity of the sewage treatment plant, before the project can be sold to the taxpayer who foots the bill.

"Generally, if the business and professional men and the labor unions back a project, it will pass."

REPORT FROM ABROAD

Progress in the Detergent Battle

British Ministry reviews conditions at 100 sewage plants and reports on studies to suppress foam

by **JOHN FINCH**, *Manager, Sewage Disposal Department, Rotherham, England*

AN interim Report by the Detergents Committee of the British Ministry of Housing and Local Government has been presented to the sewage field. It may be a best-seller for the Stationery Office on account of the tremendous interest that has resulted from the introduction of detergents and their complementary sewage treatment problems. Many sewage treatment authorities, plant operators and engineers, have anxiously awaited a report from this body. It is considered to represent the start of a planned attack on the detergent problem, with a view to its solution; thus, the issuing of this interim report is a step in the right direction.

Unfortunately, interim reports seldom are able to do more than correlate and marshal facts and, to some extent, evaluate the magnitude of the problem. The report of the Detergents Committee does not vary a great deal from the general pattern of such reports.

By the time this article appears in print, one of Great Britain's best "fact-finders" in the sewage field, C. B. Townend—of Middlesex, Eng., will be in the United States extracting facts from many readers of this journal. He will collect data relating to the problem of detergents, and the methods employed to combat the problem at sewage treatment plants.

Report on Plant Conditions

The Committee states that a full report can be made only after extensive further investigations. Such investigations are bound to require a considerable time, and may extend to a year or more. Besides studying the evidence of many other authorities, the Committee has made a detailed assessment of conditions at over a hundred sewage treatment plants; it has encouraged a number of experiments in the suppression of foam, and has instigated research into methods for reliably determining small concentrations of detergents in sewage. At the same time a survey has been made of the various effects of the use of detergents in the U. S., with details of the various measures adopted to deal with them.

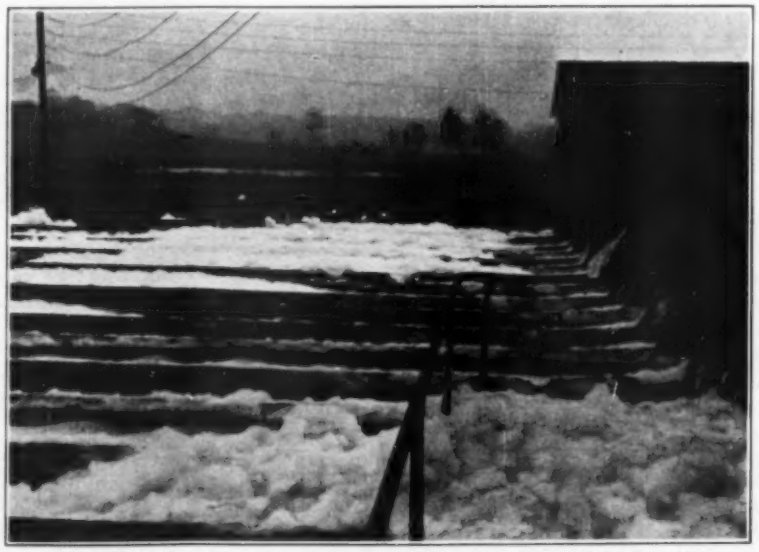
The Committee's report of other investigations which are proceeding includes reference to further experimental work on the toxicity of detergents to fish, continued sampling of certain rivers, and further chemical examination of the nature and properties of detergents. It also describes a detailed study, at certain selected sewage treatment plants, of the effects of detergents on the various treatment processes.

It is stated in the report that the types of detergent most widely sold at present produce foam, and also that the various manufacturers of these say that the only detergents which are both efficient and acceptable to general users are those which have this property. There would appear to be some lack of unanimity among detergent manufacturers about foaming, for it is only a short time ago that one of the largest manufacturers in Great Britain published an advertisement to the effect that foaming had no relation to efficiency. (See *Report From Abroad*, June, 1953.)

How to Prevent Foaming

It is a great pity that this controversy and divergence of opinion on the part of the detergent manufacturers should be in the minds of sewage treatment plant operators and designers, at a time when a special Committee is probing into the problem. Quite obviously, there is a very simple potential solution to the frothing problem; all the activated sludge plants in the country might be benefited if the manufacturers found it possible to agree on the principle of "to froth or not to froth."

In the meantime, one very distin-



FROTHING due to mechanical aeration in a plant treating industrial wastes

guished sewage engineer in Great Britain has stated that he will not consider designing another activated sludge plant until the foaming problem has been successfully overcome. Many other designers are of the same opinion. This situation can only be considered a retrograde step towards the adoption of inferior methods of purification, forced on the public health service as a direct result of the influence of detergents on sewage treatment processes.

The Committee is concentrating at the moment upon the possible effects of detergents on sewage purification, in an attempt to determine if detergents are adding to operating difficulties. It plans to learn if detergents are causing any deterioration in the standard of effluent being discharged to the rivers, particularly those supplying water to riparian owners, and to statutory water undertakers drawing water for public supply. It is of interest to note that the Committee is convinced that accurate methods of determining small concentrations of detergent in sewage and trade effluents have still to be devised.

That substantial proportions of detergents are being discharged to the rivers is beyond doubt; this fact is evidenced by analyses of river waters, and by the effects of the discharge of detergents into river waters during dry weather. In the case of the river passing my own office door, the condition may be gauged somewhat from the photographs included in the text One of these photographs is taken just below a weir in the river and the other is taken from the same spot looking down-stream for several hundred yards. Analyses of water from this river, which is not large by U.S. standards, indicate the detergent content, expressed in terms of Teepol (20 per cent active sodium alkyl sulphate) to be about 7-10 ppm in dry weather. River weirs can very easily become a source of nuisance as producers of froth, when the river water contains fair concentrations of detergents.

ABOVE—Froth on the river below the author's treatment plant
BELOW—The plant effluent weir, cause of the detergent froth

Mechanical Aerators Also Foam

The observation is often made that mechanical aerators in activated sludge plants do not produce foam during the course of agitating detergent-containing settled sewage. This statement may be put into its true perspective by the photograph illustrating foam being produced by a Bio-aeration plant dealing with an industrial sewage containing comparatively large concentrations of detergent. Similar examples may be quoted of other mechanical aerators producing foam in almost comparable proportions, particularly when the aerators do a fair job of work and produce effluents attaining a high standard of purification.

The effects of detergents on sewage treatment are, of course, not wholly concerned with foaming. At a recent meeting of the Institute of Sewage Purification, held to discuss the effects of detergents upon sewage treatment processes, the representative of a prominent detergent manufacturer, stated that when detergents (which have previously given zero B.O.D. with standard dilution water) were inoculated with effluent from percolating filters which had been treating detergent - containing sewage, they then registered B.O.D. values of the order of 30,000 to 40,000 ppm. These results seem to indicate the presence in the percolating filters of organisms acclimatized to the detergent-containing sewage, and to confirm to some extent the investigations of Eckenfelder and Hood who reported similar results in the U.S.

Chemical Waste Treatment

An important technical paper was very recently presented to a meeting of the Institute of Sewage Purification by Dr. I. S. Wilson describing the treatment of chemical wastes at the Monsanto plant at Ruabon in Wales.

The Ruabon factory of the Monsanto Company produces a variety of organic chemicals, the most important of which are synthetic phenol, salicylic acid, aspirin, phenacetin, phthalic anhydride and esters, benzoic acid, many chemicals for use in rubber processing, and a number of disinfectants and weed killers. These are quite a fright-

ening array of materials with which to confront any biological process of treatment, but they proved not sufficiently frightening to deter the Monsanto Company from the task of carrying out very comprehensive investigations into the treatment of these waste materials before discharge to the stream.

With expanding production of the Ruabon plant, increasing difficulty was experienced in the disposal of waste effluents. The system of soak-away pits, which had proved satisfactory in former times, was unsuitable for treating large volumes of liquor. If use was to be made of the River Dee for effluent dilution, exceptional precautions had to be taken to ensure that the effluent discharge was innocuous to the flora and fauna of this famous salmon fishing stream. Furthermore, the city of Chester uses the River Dee as its source of public water supply.

Disposal by means of the local sewage treatment plant at Wrexham U.D.C. was not possible, as the volumes involved were such that the sewage treatment plant had capacity only for treating a dry weather flow of little more than 10 per cent of the volumes of trade effluent being discharged from the Monsanto plant.

In-Plant Study

The Company therefore undertook the task of treating the wastes at the source and controlling their rate of discharge in such a way that the load on the river should never give cause for complaint from the River Authority nor from fishing interests. In consequence, the Monsanto Company has spent a considerable sum of money in seeking a solution to their problem, and has not in any way sought to evade its heavy responsibilities. The new biological treatment plant is, they believe, the solution to their problems.

It is of interest to note that the initial action in the Monsanto program of research into the treatment of their trade effluents was taken by Dr. Nickell, the Managing Director of the firm at that time, who visited the U. S. to study American practice in industrial waste treatment. As a result of this visit, it was decided to carry out investigations along the lines of units operating at the Dow Chemical Company, treating mixed wastes of a composition not entirely unlike that from the Ruabon plant.

Biological Filter Scheme

The new biological treatment plant comprises a straightforward, re-circulation percolating filter scheme, complete with balancing tanks, storage tanks, mixing chambers, lime mixing equipment, primary settling tanks, clarifiers and sludge treatment circuit. In addition to the treatment plant proper, the Monsanto Company has equipped a laboratory for carrying out long range investigations into the biological treatment of various wastes. Pilot plants in operation include a batch of twelve small-scale percolating filters, a mechanical aeration activated sludge plant (Kessener brush type) and a diffused air plant using dome diffusers.

It is interesting to note Dr. Wilson's observations in respect of the diffused air and mechanical aeration plants. Referring to the operation of the plants he states that only about 4 per cent of the oxygen supplied to the diffused air plant is used for oxidation, the bulk of the air being required for liquor agitation. He states that the use of compressed air for aeration is uneconomical in comparison with mechanical methods; and that, in spite of the need for larger settling tank capacity for the sludge separation, the Kessener system has more in its favor. However, he considers that the efficiency of both these systems falls short of possible achievement in this field, and I think that he will find a good number of supporters with the same or similar views.

It is not possible in the space at disposal to adequately deal with Dr. Wilson's contribution, which details a wealth of experimental data. His researches must be considered an outstanding example of an industrialist's attempts to deal with the trade waste problem.

Postscript

During the month of April, I attended an international Conference of the Centre Belge d'Etude et de Documentation des Eaux, held during the course of the Foire Internationale de Liége (Belgium). There I had the pleasure once again of meeting a number of colleagues and acquaintances in the trade waste and sewage treatment field remote from Great Britain. Among these was Dr. Rudolfs, who had come south from Holland to present a paper on the treatment of wastes resulting from the production of antibiotics. Dr. Rudolfs looked very well indeed and was in very good form at the Conference table.

The proceedings during the three or four days activities were varied in character and of a high standard; some thirty to forty technical contributions were presented and discussed at the technical sessions, all of which were well attended.

Symons to Coordinate N.Y.U. Pollution Studies

Dr. George E. Symons, consultant and technical editor in air and water pollution, has been appointed a research associate in the Research Division of New York University's College of Engineering. On a part-time basis, he will coordinate the technical and administrative problems involved in the Division's air and water pollution studies.

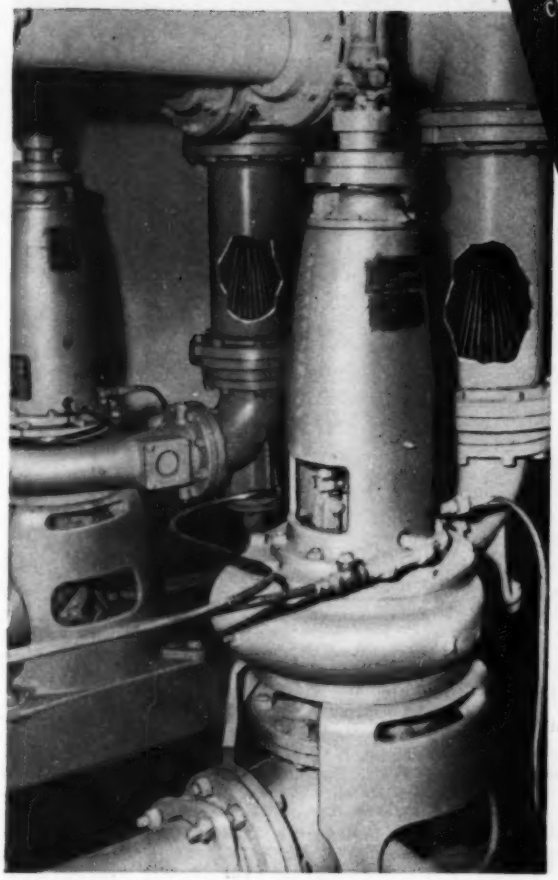
Formerly managing editor of *Water & Sewage Works*, Dr. Symons edited the ninth edition of "Standard Methods for the Examination of Water and Sewage." He was co-compiler of the 20-year index of "Sewage Works Journal," and was editorial coordinator of the American Water Works Association's "Manual of Water Quality and Treatment."

A fellow of the American Public Health Association, Dr. Symons is a member of Sigma Xi, A.C.S., A.I.Ch.E., A.S.C.E., A.W.W.A., and New York State Society of Professional Engineers. He is a past president of the New York Sewage and Industrial Waste Association. Dr. Symons received his doctor's degree in sanitary engineering chemistry from the University of Illinois in 1932.

The Engineering Research Division of New York University conducts basic and applied research in air and water pollution for several sponsors, including industry and government agencies. Research in water pollution, sewage and water works is conducted in the Lewis Van Carpenter Sanitary Engineering Research Laboratory.

Did'ya Know?

That, if the earth's surface was smoothed out calculations show that the entire surface of the globe would be covered with water to a depth of more than two miles.



CHICAGO SEWAGE EQUIPMENT

FLUSH-KLEEN Sewage Ejectors

More than 12,000 installed in lift stations, buildings and ships

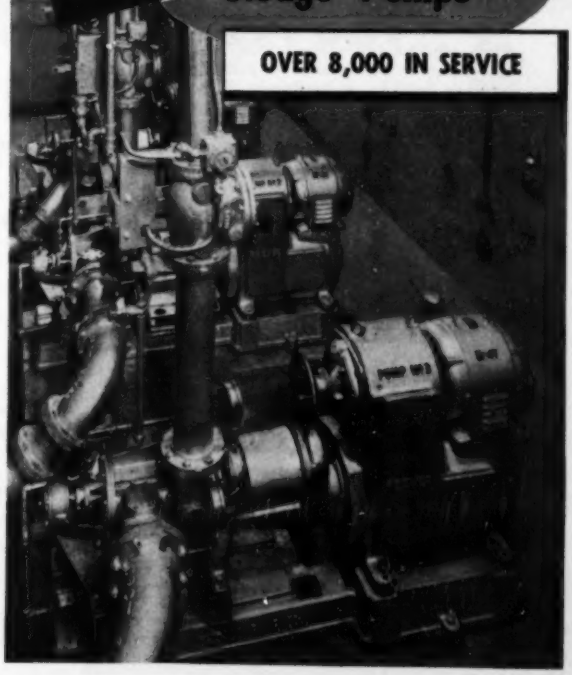
Flush-Kleens can't clog because rags never reach the impeller. Specially designed strainers in the discharge line retain all coarse matter. Sewage flows over the strainer and through one of the pumps to the wet well. When the pumps operate alternately they pump only strained sewage. No rags or coarse material ever pass through the pump casing. Each strainer is automatically flushed clean during its pumping cycle.

One of 11 Flush-Kleen Lift Stations installed in the City of Portland, Oregon. The discharge line has been cut away to show the strainer. These stations were designed by Stevens and Koon for the Engineers Portland Sewerage Project.

CHICAGO SEWAGE EQUIPMENT

SCRU-PELLER Sludge Pumps

OVER 8,000 IN SERVICE



Scru-Peller Pumps are designed specifically for pumping primary sludge, are positive in operation and truly clog-proof.

Continuous multiple shearing action is provided by stellited cutting edges of the screw and eight stellited cutting bars positioned in the screw and pump housings.

Heavy-duty ball bearings at each end of the screw and impeller shaft eliminate strain and vibration, permitting pump to withstand sudden and severe overload shocks.

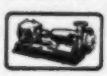
Three of the 27 Scru-Peller Pumps installed at the Hyperion Sewage Treatment Plant, Los Angeles, California. Board of Public Works and Metcalf & Eddy, Engineers.

CHICAGO PUMP COMPANY

SEWAGE EQUIPMENT DIVISION

622 DIVERSEY PARKWAY — **CHICAGO 14, ILLINOIS**

Flush Kleen, Scru-Peller, Plunger Horizontal and Vertical Non-Clogs Water Seal Pumping Units, Samplers



Swing Diffusers, Stationary Diffusers, Mechanical Aerators, Combination Aerator-Clarifiers, Comminutors.

Free to motor users

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PACKED WITH FACTS ABOUT

VARIABLE SPEEDS

Here's a booklet that presents startling facts about variable speeds. It tells how to apply U. S. Varidrive motors to your equipment, ways to get more productive manhours, methods of improving quality of workmanship, more efficient plant operations, and lists savings you can make in power and payroll. This valuable engineering booklet is profusely illustrated in striking colors. It details latest improvements and shows how you can have speeds from 2 to 10,000 rpm at your command. Illustrates 28 Varidrive models. ¼ to 50 h.p. Request this amazing 16-page booklet for latest data on variable speeds.

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—The miracle motor

U. S. ELECTRICAL MOTORS Inc.

Los Angeles 54, Calif. Milford, Conn.

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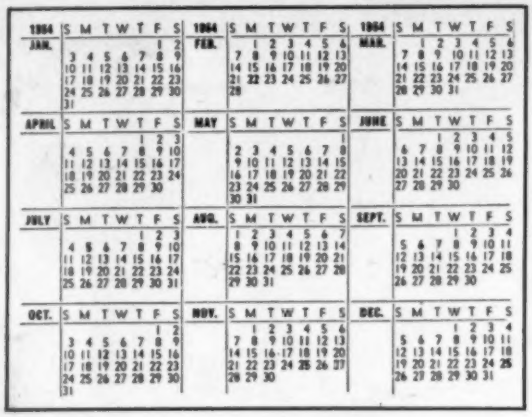
CITY_____ ZONE____ STATE_____

Meetings Scheduled



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July 25-31—Sao Paulo, Brazil *(Univ. of Sao Paulo)*
INTER-AMERICAN CONFERENCE SANITARY ENGINEERING. Write to General Secretariat, Fourth Inter-American Conference San. Eng. Caiza Postal 8099, Sao Paulo, Brazil.

Aug. 11—Bingham, Me.
MAINE WATER UTILITIES ASSOCIATION. Sec'y, Earle A. Tarr, 15 Bowdoin St., Winthrop, Me.

Aug. 23-27—Durham, N.C. *(Duke Univ.)*
NORTH CAROLINA WATER WORKS OPERATORS' SHORT COURSE. (15th Annual Course). Chairman, J. H. Henderlite, 1515 Elizabeth Ave., Charlotte, N.C.

Aug. 23-25—State College, Pa. *(College Dormitories)*
PENNSYLVANIA WATER WORKS OPERATORS ASSOCIATION. Sec'y, R. R. Kountz, Pennsylvania State College, State College, Pa.

Aug. 25-27—State College, Pa. *(College Dormitories)*
PENNSYLVANIA SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, B. S. Bush, Dept. of Health, Kirby Health Center, Wilkes-Barre, Pa.

Sept. 8-11—Digby, Nova Scotia *(Digby Pines Hotel)*
MARITIME PROFESSIONAL MEETING, ENGINEERING INSTITUTE OF CANADA, ASSOCIATION OF PROFESSIONAL ENGINEERS. Write, G. W. Frey, P.O. Box 1507, Halifax, N.S.

Sept. 9-10—Montauk, N.Y. *(Montauk Manor)*
NEW YORK SECTION A.W.W.A. (Annual Fall Meeting). Sec'y, Kimball Blanchard, 50 West 50th Street, New York, N.Y.

Sept. 14-16—Waterloo, Iowa *(Hotel Russell-Lampson)*
IOWA SEWAGE WORKS ASSOCIATION. Sec'y, L. F. Skorczeski, 207 South 15th Ave., Marshalltown, Ia.

Sept. 15-17—Muskegon, Mich. *(Occidental Hotel)*
MICHIGAN SECTION A.W.W.A. Sec'y, T. L. Vander Velde, Dept. of Health, Lansing 4, Mich.

Sept. 19-22—Atlantic City, N. J. *(Hotel Claridge—Exhibits, Convention Hall)*
AMERICAN PUBLIC WORKS ASSOCIATION. Exec. Dir., Donald Herrick, 1313 E. 60th St., Chicago 37, Ill.

Sept. 20-22—Nashville, Tenn. *(Andrew Jackson Hotel)*
KENTUCKY-TENNESSEE SECTION A.W.W.A. Sec'y, J. Wiley Finney, Jr., 420 6th Ave., N., Nashville, Tenn.

Sept. 20-22—Nashville, Tenn. *(Andrew Jackson Hotel)*
KENTUCKY-TENNESSEE INDUSTRIAL WASTES & SEWAGE WORKS ASSOCIATION, Sec'y, R. Paul Farrell, 420 6th Ave. N., Nashville 3, Tenn.

(Continued on page 78A)

When you buy HYDRANTS and VALVES for your city waterworks system...

LOOK TO THE YEARS AHEAD, TOO!

EDDY can supply replacement parts for any Eddy Valve or Hydrant ever installed! This is important to you because the Valves and Hydrants you buy today must serve several generations yet unborn. You want no "orphans" in your system. Eddy Hydrants and Eddy Valves are backed by Eddy Valve Company's 104 years of dependable operation—your assurance that replacement parts will be available during the years to come.

EDDY Bronze-Mounted HYDRANTS

are built for dependability and lasting service. They open smoothly *with* the pressure and close without water hammer. One man can easily remove all operating mechanism for inspection and repair. Positive drip action automatically drains the standpipe, safeguarding against freeze-ups. Stem held in place below main valve means no water loss due to a bent stem.

EDDY Bronze-Mounted GATE VALVES

offer simplicity of design, trouble-free operation and enduring service. From the engineering drawing boards through all stages of manufacture, they are step by step a truly "finished" product of workmanship. These factors, added to personal experience, are reasons why progressive water works men have relied on Eddy Valves for years.

Eddy Hydrants and Valves are available with bell, flange or mechanical joint connections to fit any existing or planned installation.

Send today for full information on the complete line of Eddy Valves and Hydrants. No obligation.

EDDY VALVE COMPANY

A Subsidiary of James B. Clow & Sons

WATERFORD, NEW YORK

HAVE AN ADEQUATE
WATER SUPPLY
ALL YEAR ROUND!
with the exclusive
RANNEY®
WATER COLLECTOR
FOR YOUR CITY
Now in use by the following volume water consumers: American Cyanamid Co., Wallingford, Conn.; Boise Water Corporation, Boise, Idaho; E. I. DuPont deNemours & Co., Inc.; Granite City Steel Co., Granite City, Ill. City of Manitowoc, Wis.
Millions of Gallons
The Ranney Collector is a unique kind of "well." It can produce more pure, cool water from one well, for less money, than ever possible before, with multiple wells. This greater yield adds millions of gallons to your present water supply, with fewer pumps and personnel. Installation and maintenance costs are held to a minimum.
Eliminates Filters
You can avoid the cost of maintaining an elaborate filter plant and water treatment station. The Ranney Method of water collection supplies a huge volume of naturally filtered water through exclusively engineered, screened horizontal well points that never clog. It pays to investigate the Ranney Method today!
I believe a Ranney Water Collector can save money for my community. Please send me further information.
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Company
Address
RANNEY METHOD WATER SUPPLIES, INC.
Water Supply Engineers and Contractors
841 Alton, Columbus 19, Ohio · Dept. WS 31

(Continued from page 76A)

Sept. 22-24—Dayton, Ohio *(Biltmore Hotel)*
OHIO SECTION A.W.W.A. Sec'y, M. E. Druley, Dayton Power & Light Co., Wilmington, Ohio.

Sept. 22-24—Regina, Sask. *(Saskatchewan Hotel)*
WESTERN CANADA WATER & SEWAGE CONFERENCE. Sec'y, W. J. Waddell, 3610 Manchester Road, Calgary, Alberta.

Sept. 22-24—Grand Forks, N. D. *(Dakota Hotel)*
NORTH DAKOTA WATER & SEWAGE WORKS CONFERENCE. Sec'y, Jerome H. Svore, State Dept. of Health, Bismarck, N.D.

Sept. 22-24—Atlanta, Ga. *(Ga. Institute of Technology)*
GEORGIA WATER & SEWAGE SHORT SCHOOL. Write, A. T. Storey, 1210 Hemphill Ave., N.W., Atlanta, Ga.

Sept. 26-28—Jefferson City, Mo. *(Governor Hotel)*
MISSOURI SECTION A.W.W.A. Sec'y, Warren A. Kramer, State Office Bldg., Jefferson City, Mo.

Sept. 26-28—Jefferson City, Mo. *(Hotel Governor)*
MISSOURI WATER & SEWAGE CONFERENCE. Sec'y, Warren Kramer, State Office Building, Jefferson City, Mo.

Sept. 28-30—Green Bay, Wis. *(Northland Hotel)*
WISCONSIN SECTION A.W.W.A. Sec'y, Leon A. Smith, City Hall, Madison 3, Wis.

Sept. 28-30—Mitchell, S. D. *(Lawler Hotel)*
SOUTH DAKOTA WATER & SEWAGE WORKS. Sec'y, Charles E. Carl, State Dept. of Health, Pierre, S. D.

Oct. 4-5—Moncton, New Brunswick, Can. *(Hotel Brunswick)*
MARITIME BRANCH, AMERICAN WATER WORKS ASSOCIATION. Sec'y, J. D. Kline, P.O. Box 574, Halifax, N.S.

Oct. 4-6—Poland Spring, Me. *(Poland Spring House)*
NEW ENGLAND WATER WORKS ASSOCIATION. (73rd Annual Convention). Sec'y, Jos. C. Knox, 204 Tremont Bldg., Boston, Mass.

Oct. 4-6—Atlantic City, N.J. *(Chalfonte-Haddon Hall)*
PENNSYLVANIA MUNICIPAL AUTHORITIES ASSOCIATION. Sec'y, Claude C. Fogelman, 1717 Main St., Northampton, Pa.

Oct. 6-8—St. Paul, Minn. *(Lowry Hotel)*
MINNESOTA SECTION A.W.W.A. Sec'y, Leonard N. Thompson, Gen. Mgr., Water Department, St. Paul, Minn.

Oct. 11-14—Cincinnati, O. *(Netherland Plaza Hotel)*
FEDERATION OF SEWAGE & INDUSTRIAL WASTES ASSOCIATIONS. (27th Annual Convention). Exec. Sec'y, W. H. Wisely, 325 Illinois Bldg., Champaign, Ill.
(In conjunction with)
OHIO SEWAGE & INDUSTRIAL WASTES TREATMENT ASSOCIATION. Sec'y, Ward E. Conrad, 301 Ohio Departments Bldg., Columbus 15, Ohio.

Oct. 11-15—Buffalo, N.Y. *(Statler Hotel*—Tech. Sessions, *Memorial Auditorium)*
AMERICAN PUBLIC HEALTH ASSOCIATION. (Annual Meeting). Sec'y, Mrs. W. R. Walsh, A.P.H.A., 1790 Broadway, New York, N.Y.

Oct. 13—Brunswick, Me.
MAINE WATER UTILITIES ASSOCIATION. Sec'y, Earle A. Tarr, 15 Bowdoin St., Winthrop, Me.

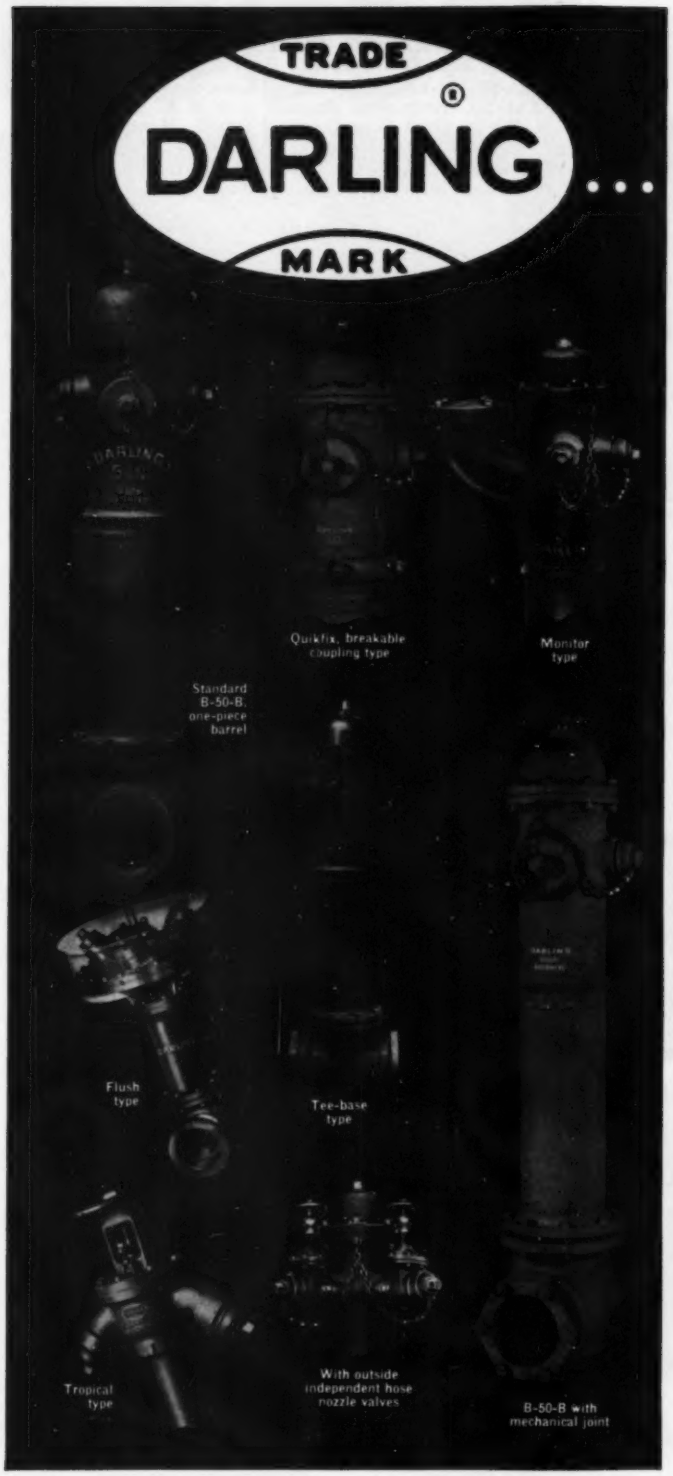
Oct. 13-15—Cedar Rapids, Iowa *(Roosevelt Hotel)*
IOWA SECTION A.W.W.A. Sec'y, H. V. Pedersen, Municipal Bldg., Marshalltown, Iowa.

Oct. 17-20—El Paso, Texas *(Cortez Hotel)*
SOUTHWEST SECTION A.W.W.A. Sec'y, Leslie A. Jackson, Robinson Memorial Auditorium, Little Rock, Ark.

Oct. 18-20—*Pittsburgh, Pa. (Hotel William Penn)*
ENGINEERS SOCIETY OF WESTERN PENNSYLVANIA. (15th Annual Water Conference). Sec'y, W. M. Porter, Hotel Wm. Penn, Pittsburgh, Pa.

Oct. 18-22—New York, N.Y. *(Statler Hotel)*
AMERICAN SOCIETY CIVIL ENGINEERS. (Annual Meeting). Exec. Sec'y, Wm. N. Carey, 33 West 39th St., New York, N.Y.

(Continued on page 80A)



DARLING ... HYDRANTS

- **Featuring new ball-bearing operated B-50-B design**
- **Types and sizes for every requirement**

YOU'LL be ahead on many counts when you specify modern Darling Fire Hydrants. Just for example . . .

Your system can include hydrant types exactly right for special or unusual service needs — breakable coupling types where traffic damage is common, concealed flush types for airport and pavement installation, Tee-base types to eliminate lateral connections where practicable. These and a few of the other types are shown here.

Equally important, Darling's unique B-50-B development (now available in all except the Tropical type) introduces *ball-bearing* operation combined with "O" ring seals. Result: a packless, dry-top hydrant. No packing gland maintenance. Operating threads and bearings *stay* lubricated and water can't reach them. Operation is far easier, far faster . . . and you avoid lots of maintenance time and trouble.

Send for complete information. Better still, ask to have a Darling engineer check your needs and tell you just what you stand to gain with Darling Hydrants.

TRADE ® DARLING MARK

DARLING VALVE & MANUFACTURING CO.

Williamsport 11, Pa.

Manufactured in Canada by The Canada Valve & Hydrant Co., Ltd., Brantford 7, Ont.

(Continued from page 78A)

Oct. 19-22—Atlantic City, N.J. *(Chalfonte Hotel)*
PENNSYLVANIA WATER WORKS ASSOCIATION. Sec'y, David Dunlap, 504 N. Second St., Harrisburg, Pa.

Oct. 24-27—Birmingham, Ala. *(Tutwiler Hotel)*
ALABAMA-MISSISSIPPI SECTION A.W.W.A. Sec'y, Charles W. White, State Department of Health, Montgomery, Ala.

Oct. 26-29—Long Beach, Calif. *(Wilton Hotel)*
CALIFORNIA SECTION A.W.W.A. Sec'y, Henry F. Jerauld, 1040 Manzanita, Pasadena, Calif.

Oct. 27-28—Springfield, Ill.
ILLINOIS WATER WORKS OPERATORS CONFERENCE. Sec'y, Clarence W. Klassen, State Dept. of Health, Springfield, Ill.

Oct. 27-29—Baltimore, Md. *(Belvedere Sheraton Hotel)*
CHESAPEAKE SECTION A.W.W.A. Sec'y, Carl Lauter, 6955 33rd St., Washington 5, D.C.

Oct. 28—Bridgeport, Conn. *(Hotel Stratfield)*
NEW ENGLAND SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, Stephen M. Hurley, Jr., 331 State Office Bldg., Providence, R. I.

Nov. 3-5—Richmond, Va. *(Jefferson Hotel)*
VIRGINIA SECTION A.W.W.A. Sec'y, J. P. Kavanaugh, 915 Colonial-American Bank Bldg., Roanoke 11, Va.

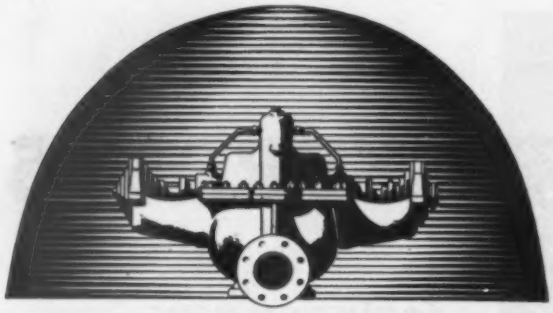
Nov. 4-6—Atlantic City, N.J. *(Madison Hotel)*
NEW JERSEY SECTION A.W.W.A. Sec'y, C. B. Tygert, Box 178, Newark 1, N.J.

Nov. 8-9—Huntington, W.Va. *(Hotel Prichard)*
WEST VIRGINIA SECTION A.W.W.A. Sec'y, Harry K. Gidley, State Dept. of Health, Charleston 5, W. Va.

Nov. 7-10—St. Petersburg, Fla. *(Soreno Hotel)*
FLORIDA SECTION A.W.W.A. Sec'y, Wm. W. Aultman, Box 316, Coconut Grove Sta., Miami 33, Fla.

Nov. 8-10—Asheville, N.C. *(George Vanderbilt Hotel)*
NORTH CAROLINA SECTION A.W.W.A. Sec'y, E. C. Hubbard, P.O. Box 2091, Raleigh, N.C.

Nov. 9-10—Colorado Springs, Colo. *(Broadmoor Hotel)*
ROCKY MOUNTAIN SECTION A.W.W.A. Sec'y, Geo. J. Turre, Box 600, Denver, Colo.



PEERLESS HORIZONTAL PUMPS

For: Water Supply, Sewage and Waste Disposal, Boosting, Fire Protection, Cooling Tower and Process Services.

PEERLESS PUMP

Write for descriptive Bulletin on type you require.

PEERLESS PUMP DIVISION
Food Machinery and Chemical Corp.
Factories: Los Angeles, Cal.; Indianapolis, Ind.
Offices: New York; Chicago, St. Louis; Atlanta; Phoenix; Dallas, Plainview and Lubbock, Texas; Fresno; Los Angeles; Albuquerque.

PEERLESS BUILDS DEPENDABLE PUMPS

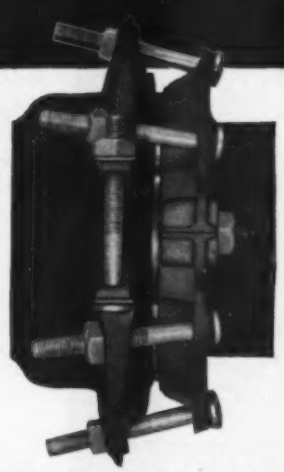
Tough and Strong LASTS EXTRA LONG

KONIK metal beats the rigors of a tough culvert life—it resists rust and fights element corrosion. The Continental open hearth steel plus copper, nickel and chromium does it. These sheets are made especially for culvert use because they stand more rough abuse. Continental Steel Corporation, Kokomo, Indiana.

ASK TO SEE THE KONIK CULVERT METAL WARRANTY
Continental culvert distributors are glad to show the KONIK warranty . . . and the certified analysis that assures the longer culvert life of KONIK metal.

CONTINENTAL STEEL CORPORATION
FENCE • BARBED WIRE • POSTS • NAILS • ETC.

REPAIR BELL AND SPIGOT JOINT LEAKS



SKINNER-SEAL Bell Joint Clamp. Gasket is completely sealed. 2" to 42" incl. Write for catalog.

M. B. SKINNER COMPANY
SOUTH BEND, INDIANA

St. Louis Turbidimeter

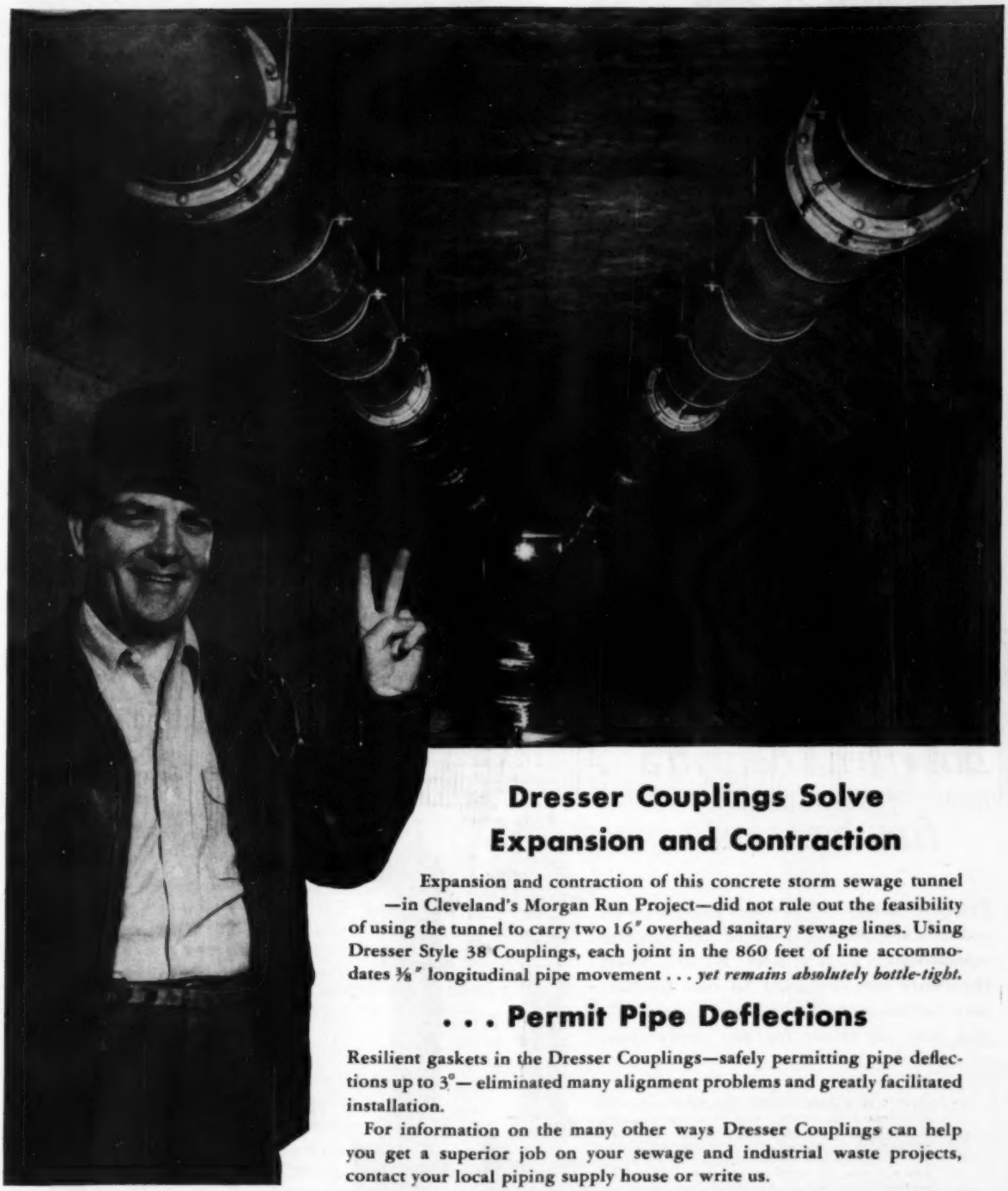
For measuring turbidity of water. Consists of cast aluminum housing, adjustable lamp . . . two vertical walls for holding two Nessler tubes.

This apparatus comes ready to plug into 115 volt line, comes fully equipped for normal operation.

WRITE:

Phipps & Bird, Inc.
P. O. Box 2V Richmond 5, Va.

DOUBLE-TIGHT!



Dresser Couplings Solve Expansion and Contraction

Expansion and contraction of this concrete storm sewage tunnel —in Cleveland's Morgan Run Project—did not rule out the feasibility of using the tunnel to carry two 16″ overhead sanitary sewage lines. Using Dresser Style 38 Couplings, each joint in the 860 feet of line accommodates ⅜″ longitudinal pipe movement . . . *yet remains absolutely bottle-tight.*

. . . Permit Pipe Deflections

Resilient gaskets in the Dresser Couplings—safely permitting pipe deflections up to 3°— eliminated many alignment problems and greatly facilitated installation.

For information on the many other ways Dresser Couplings can help you get a superior job on your sewage and industrial waste projects, contact your local piping supply house or write us.

DRESSER® COUPLINGS

Dresser Manufacturing Division, 69 Fisher Ave., Bradford, Pa. (One of the Dresser Industries). Warehouses: 1121 Rothwell St., Houston; 101 S. Airport Blvd., S. San Francisco. Sales offices also in: New York, Philadelphia, Chicago, Toronto.

Toronto Water and Sewerage Functions to Be Combined

Water supply and sewerage is to be under unified control in greater Toronto. A bill introduced in Ontario legislature provides for federation for certain purposes of 13 municipalities in Toronto area, other powers of local municipalities being continued. The Metropolitan municipality is to take over and operate all existing works in area for production and wholesale distribution of water to component municipalities, and to assume all outstanding debts for such works.

A Lot of Water*

We all know that the Great Lakes are large, but this writer was astounded when he did some comparing and found that Lake Superior is larger than the state of South Carolina. Lake Huron is as large as Maryland, New Hampshire, and Delaware combined. Lake Michigan is nearly as large as West Virginia. Lake Erie is larger than Vermont. And Lake Ontario is nearly as large as New Jersey.

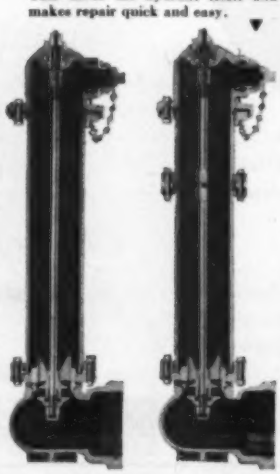
The total area of the Great Lakes is 94,710 square miles, and the total area of the seven states named above is 94,619 square miles. Or, if we could make one giant lake out of them, stretching 3,000 miles from New York to Los Angeles, that giant lake would be over 31 miles wide. Difficult to conceive, but true. And, what a source of water supply that would make.

*Contributed by W. F. Schophorst, M.E.

Friction's needed for a match but it's no help in a fire hydrant

Friction causes loss of water pressure and reduces the effectiveness of fire-fighting equipment. That's why R. D. Wood Hydrants are designed to cut friction way down—and why so many communities rely on them for fire protection.

The R. D. Wood Hydrant can be furnished with breakable flange and stem coupling at extra cost. Both are built to break with a heavy blow. This saves the hydrant itself and makes repair quick and easy.



THE R. D. WOOD SWIVEL JOINT HYDRANT: All internal parts, including drain valve seat, removable through barrel • all-bronze stuffing box • completely revolving head • compression-type valve, cone shaped to prevent water hammer • automatic drain valve • bronze main valve seat screws directly into elbow with straight, not tapered threads • mechanical-joint pipe connections if specified

R.D. Wood Swivel Joint Hydrants

Public Ledger Building, Philadelphia, Pa.

Manufacturers of "Sand-Spun" Pipe (centrifugally cast in sand molds) and R. D. Wood Gate Valves

Powers Appointed to P.H.S. Pollution Advisory Board

Thomas J. Powers, supervisor of waste disposal for The Dow Chemical Company, has been appointed by President Eisenhower as industry representative on the water pollution control advisory board of the Public Health Service. The official commission was transmitted by Mrs. Oveta Culp Hobby, Secretary of the Department of Health, Education and Welfare.

The Board serves in an advisory capacity to the Surgeon-General on pol-

(*Continued on page* 84A)

"That meter-reader from the Water Department just can't pass up the chance of reading every meter he sees."

CORROSION-FIGHTING NEWS

There's only one sensible way to fight sewage corrosion: Stop it before it starts. Coating your pipe, tanks and equipment with *Pitt Chem* Tar Base Coatings before you put your plant into operation is like buying an insurance policy against corrosion problems for many years to come. Pitt Chem offers you three outstanding benefits:

1. **Longer-lasting protection.** Pitt Chem stands up to sewage corrosion 7 to 10 years longer than ordinary paints. Yet it costs no more per gallon.
2. **Economical application.** No special paint crew is required. Your own men can apply coating after a few simple instructions.
3. **Durable Bond to most materials.** Pitt Chem forms an excellent long-lasting bond with metal, masonry, cement and stone.

Add up these unique benefits and you'll agree: *No other material does such a complete job of protection at so little cost.* ● A *Pitt Chem* corrosion control booklet will gladly be sent to you on request.

W&D 4358

PITT CHEM 101—For Severest Conditions
PITT CHEM 102—Maintenance Coating
PITT CHEM 103—General Purpose Coating
PITT CHEM 104—Potable Water Service
PITT CHEM 105 AQUATAR—A Water Dispersion
PITT CHEM 106 TARMASTIC—Sealing Compound
PITT CHEM 107 PACHKOTE—Specialty Coating
PITT CHEM 110—Specialty Coating

PROTECTIVE COATINGS DIVISION
PITTSBURGH
COKE & CHEMICAL CO.
Grant Building • Pittsburgh 19, Pa.

COAL CHEMICALS • AGRICULTURAL CHEMICALS • FINE CHEMICALS • PROTECTIVE COATINGS • PLASTICIZERS • ACTIVATED CARBON • COKE • CEMENT • PIG IRON

(*Continued from page* 82A)

icies and programs of the public health service under the pollution control act.

Powers, who holds degrees in both sanitary and civil engineering, joined Dow as sanitary engineer in 1936 after having served five years with the Michigan Stream Control Commission.

He is a past president of the Michigan Sewage and Industrial Waste Association and from 1951 to 1953 served as chairman of the water pollution abatement committee of the Manufacturing Chemists' Association, of which he is still a member. From 1952 to 1953 he was chairman of the chemical industry's task group of the National Technical Task Committee on Industrial Wastes.

Powers will replace L. A. Danse of General Motors who has served on the advisory board since 1949.

Pickups from Purdue's "Sanitary Engineering News"

Don E. Bloodgood, Editor

"Many of the world's greatest discoveries and inventions are products of stubborn minds which refuse to yield to the seemingly impossible."

In Los Angeles County, California, it costs $100 per million gallons to obtain water and it costs $35 per million gallons to dispose of it.

* * *

"When the political dust has settled, history may record that the most significant decision of all those made by the politicians was the arrangement for the development of atomic energy."

* * *

A typhoid epidemic in Westerode, a small village in the Harz Mountains, resulted from seepage from a polluted stream into the spring supply.

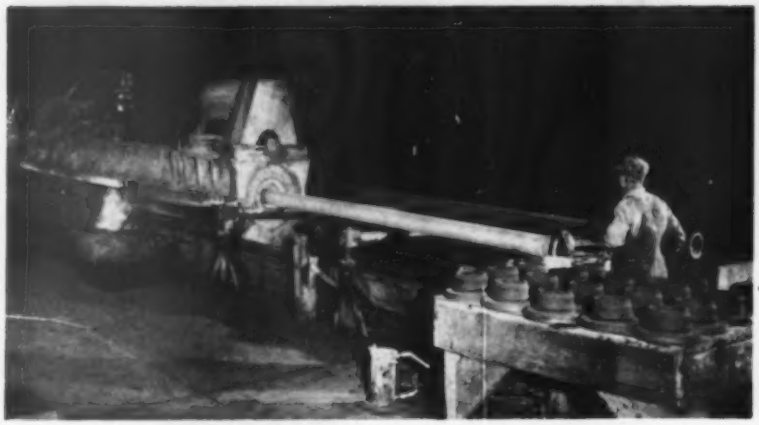
* * *

An equation is now available for calculating the water supply in eskers (gravel and sand drifts) if the precipitation, coefficient of infiltration, and area of the gathering grounds are known.

* * *

"A practical method has been developed for the clarification and re-use of soap-based laundry waste water."

PIG IRON *with a* HOLE IN IT!



Close-up view of pulling a pipe from centrifugal casting machine.

WHY McWANE-PACIFIC CAST IRON PIPE LASTS for CENTURIES

Cast Iron Pipe is an engineering product. But the "wag" who jokingly said that Cast Iron Pipe was a "chunk of pig iron with a hole in it" probably spoke with more wisdom than he realized.

Production of pig iron is the first step in refinement of iron ore. As everyone knows, iron ore has laid in the ground for untold ages of time, without rust or corrosion. The more iron is refined, the more subject it is to rust and deterioration. The less it is refined, the more durable it remains. That is why McWane-Pacific Super DeLavaud cast iron pipe, ("pig iron with a hole in it") lasts for centuries.

For details, wire or write McWANE CAST IRON PIPE COMPANY, Birmingham, Alabama, or PACIFIC STATES CAST IRON PIPE COMPANY, Provo, Utah. (Sales offices in principal cities.)

McWANE PACIFIC PIPE *Lasts for Centuries*

Packaged Chemical Feed Systems

701

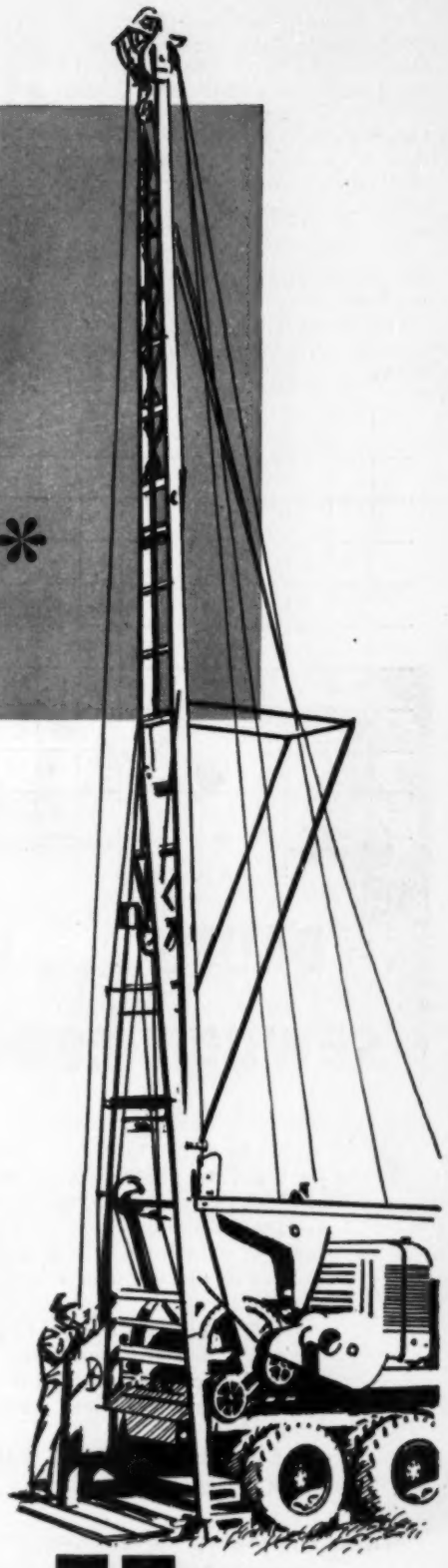
Philadelphia Pump and Machinery Co., Wynnewood, Pa., has developed several "packaged" Chemical Feed Systems for various requirements of water treating applications and other chemical single and partitioned tanks, equipped with simplex or duplex pumps to feed one or two chemicals in correct proportions for particular treating problems.

Accessory equipment includes dissolving baskets, mixing and agitating equipment, doughnut floats, liquid seals, level alarms, etc.

Conventional screw and rocker-arm adjustments of pump capacity are available. In addition, the patented PHILATROL mechanism offers either manual or automatic con-

(*Continued on page* 86A)

from 200 gpm to 600 gpm with CALGON*



Calgon raises new well capacity 200%

A new irrigation well in Arizona was developed from an initial capacity of 200 gpm to 600 gpm, an increase of 200%. This demonstrates what Calgon can do. Here are the details:

The well had a depth of 415 ft. and a diameter of 16 in. It was drilled with a cable tool rig through a ground formation of gravel, heavy rock and clay. The pipe was perforated for 85 ft. from the bottom. The initial flow was only 200 gpm, so the driller decided to develop the well with Calgon.

A charge of Calgon, surged with a swab, cleaned out the water producing strata so thoroughly that the flow was increased to 600 gpm. Such an increase in flow is not unusual; increases as high as 500% have been obtained with Calgon treatment.

Calgon is just as effective when used in old wells. Calgon is harmless in all concentrations, forms no toxic fumes, is easy and inexpensive to use. Write or phone for more information on water well cleaning with Calgon, we will be glad to discuss your specific problem with you.

CALGON, inc.

A SUBSIDIARY OF HAGAN CORPORATION

HAGAN BUILDING PITTSBURGH 30, PA.

*Calgon is the registered trade mark of Calgon Inc. for its sodium phosphate glass (sodium hexametaphosphate) products.

HAGAN
HALL
BUROMIN
CALGON

(*Continued from page 84A*)

trol of pump capacity. This mechanism permits tying into any electrical, pneumatic or hydraulic control system to accurately proportion chemicals in relation to temperature, flow, pH value, liquid level, pressure, conductivity or any other factor for which instruments are made to measure.

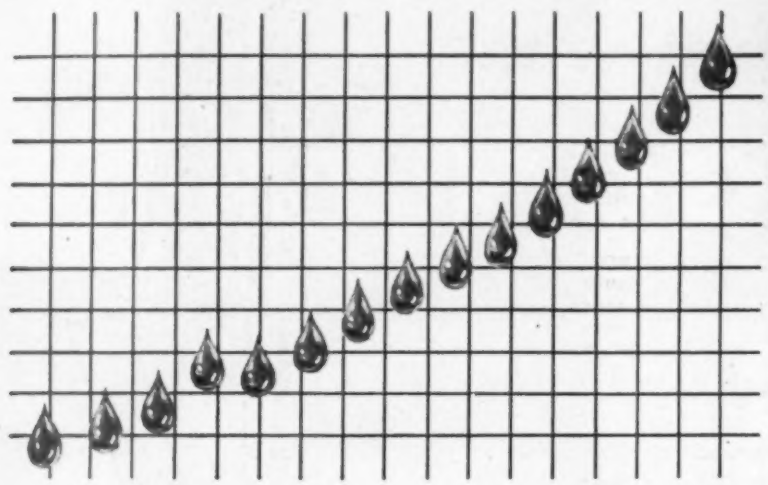
These self-contained, "packaged" Chemical feed systems are delivered complete in every respect—ready to attach to regular plant piping and to plug into existing electrical circuits.

Ferreby and Barrett Complete 25 Years With Chicago Bridge

Chicago Bridge & Iron Company, Chicago, Ill., has announced that Mr. E. D. Barrett and Mr. W. E. Ferreby, have completed 25 years' service with the Company.

Mr. E. D. Barrett started with the Company in the Drafting room in 1929, later he worked in the Erection department and Chicago shop. He was a Contracting Engineer in the Chicago sales office from 1930 until 1946, after which he was transferred to Detroit as District Sales Manager.

Mr. W. E. Ferreby started in the Advertising department of the General Sales office in Chicago, and in 1934 was transferred to the New York Sales office where he has been working primarily in export sales.



DROPS . . . that boost sewage handling costs

NEVER UNDERESTIMATE the extra load put on a sewage system by simple infiltration of soil water. Pumping costs jump . . . and disposal plant costs climb likewise.

INFILTRATION can be prevented with ATLAS JC-60,® the new plastic base sewer pipe jointing compound. JC-60 provides tight joints, strong as the pipe itself, that prevent unwanted soil water from entering your pipeline—or sewage from escaping.

Other characteristics of JC-60 provide resistant joints that positively stop root penetration—flexible joints that take normal settling without rupture . . . and numerous on-the-job advantages that speed sewer construction and reduce waste.

GET THE COMPLETE FACTS ON ATLAS JC-60
Write for Bulletin M20-3.

ATLAS JOINTING COMPOUNDS
. . . a permanent bond

ATLAS MINERAL

OTHER ATLAS PIPE JOINTING MATERIALS include GK® and SLIPJOINT GK® for sewers . . . Tegul MINERALEAD® and HYDRORINGS for cast iron water pipe.

New Adhesive for Bonding Rubber Gaskets to Concrete Pipe

702

Rubber & Asbestos Corp., Bloomfield, New Jersey, has developed a new adhesive, claimed to provide more positive anchorage of rubber gaskets to concrete pipe even under extreme climatic conditions.

The new product, trade-named "BondMaster 158C", is reported to offer more uniform application characteristics, particularly in overcoming hot weather difficulties ordinarily encountered due to evaporation of solvents. In addition to the slower solvent evaporation rate, BondMaster 158C is said to permit smoother and faster trowelling in the field than has been possible with previously existing formulations for this work.

Belschner Joins W&T Ltd.

Wallace & Tiernan, Inc., Belleville, N. J., has announced that Mr. Wilfred C. Belschner has joined the sales engineering staff of Wallace & Tiernan, Ltd. With his headquarters in Toronto, Mr. Belschner will specialize in sales equipment for treatment of sewage and industrial wastes.

Mr. Belschner, a native of Montreal, graduated from Nova Scotia Technical College with a Bachelor's Degree in Civil Engineering, followed by a Master's Degree from Virginia Polytechnic Institute where he specialized in sewage and industrial waste disposal.

Starting point for quality products

Quality products begin with quality ingredients. That's why Nialk Chemicals are used today in so many exacting applications.

for example...

NIALK LIQUID CHLORINE: Nothing is more essential to human well-being than pure, safe drinking water! That's why NIALK Liquid Chlorine — long relied upon for highest quality and uniformity — is in use today in water purification plants throughout America!

Niagara Alkali was the first producer of liquid chlorine in commercial quantities. Thanks to strict quality control — extending right down to the scrupulously clean tank cars in which it is delivered — NIALK Liquid Chlorine has continued to serve America for many years.

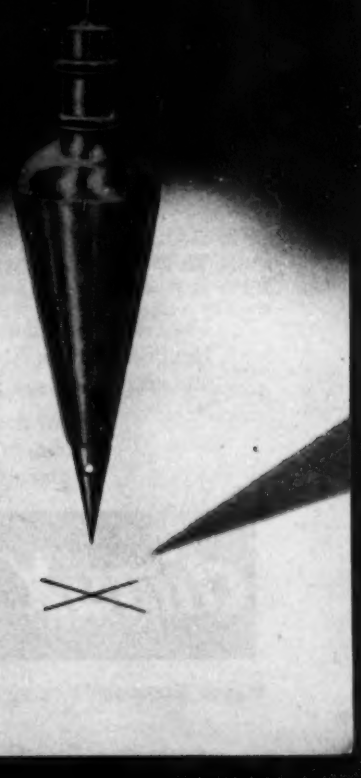
NIAGARA ALKALI COMPANY

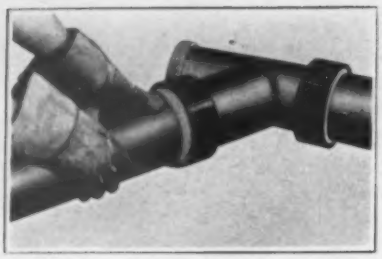
60 East 42nd Street, New York 17, New York

Nialk

- LIQUID CHLORINE
- CAUSTIC POTASH
- CARBONATE OF POTASH
- PARADICHLOROBENZENE
- CAUSTIC SODA
- TRICHLORethylene

NIAGARA (TETRACHLORO PHTHALIC ANHYDRIDE)





New "Screw-Seal" Clay Pipe

703

The Robinson Clay Product Company of Akron, Ohio, is marketing a revolutionary joint and ceramic pipe for industrial use in conveying liquids and gases.

Known as "Screw-Seal", the new joint development combines plastic with Vitrified Clay to form a leak-proof, infiltration-proof joint. Robinson industrial clay pipe, a premium grade with extra-heavy wall thickness to withstand severe service whether buried or exposed in industrial service, is manufactured with a threaded joint made of Plastisol, a vinyl resin dispersed in a fluid material, which becomes a rubber-like plastic upon heating.

"Screw-Seal" is resistant to 54 corrosive acids and to most noxious gases. It is available in four-, six- and eight-inch diameters, with standard fittings.

Robinson "Screw-Seal" employs the matching thread principle. Each clay pipe end is made dimensionally accurate in the application of plastic, which is cast directly on the pipe with the outer surface molded to a tapered thread. This provides two male-threaded ends on the clay pipe, which thus becomes an integral part for all practical purposes. Pipe lengths are joined together by means of a threaded pressure molded plastic collar with matching female threads.

To assemble the joint, the pressure molded plastic collar is threaded over the stationary clay pipe end, and the pipe to be added to the line is turned into the collar by hand. This operation is accomplished in a minute or so through three complete revolutions of the pipe by hand and a fourth and final turn with a strap wrench.

In hard-to-get-at places, use is made of a pressure molded type union in the form of a split flange bolted together at the sides. This special union joint offers quick, easy assembly when connections such as elbows, T's and Y's are required in the line, or in any situation where space limitations would prevent screwing the next pipe length into the collar. A Plastisol band is placed over the threads to assure a smooth surface for the collar.

Climax Model V-80 Engine installed in Columbus, Indiana Sewage Treatment Plant.

Columbus Discovered

. . . . it could save money by installing a dependable CLIMAX gas engine for driving a blower in its new Sewage Treatment Plant.

This 8 cylinder V-type engine has a continuous output of 143 H.P. when driving the 3000 CFM blower 765 RPM.

Until sufficient sewage gas is available, Superintendent G. F. Hendricks is cleverly blending natural gas with the sewage gas and reports satisfactory performance.

Plant designed by and built under supervision of J. M. Rotz Engineering Co., Indianapolis.

climax

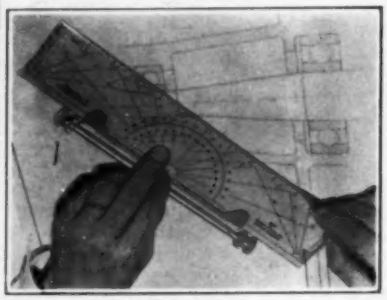
FOR COMPLETE INFORMATION, WRITE TO . . .

ENGINE AND PUMP MFG. CO.

208 So. La Salle St.

CHICAGO 4, ILLINOIS

Factory–Clinton, Ia. *District Office*–Dallas, Tex.

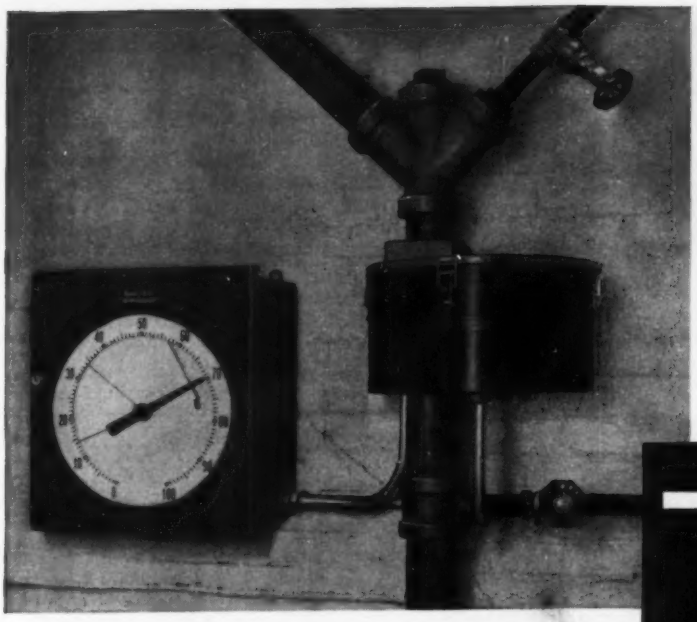


Single-Unit Pocket Drafting Device

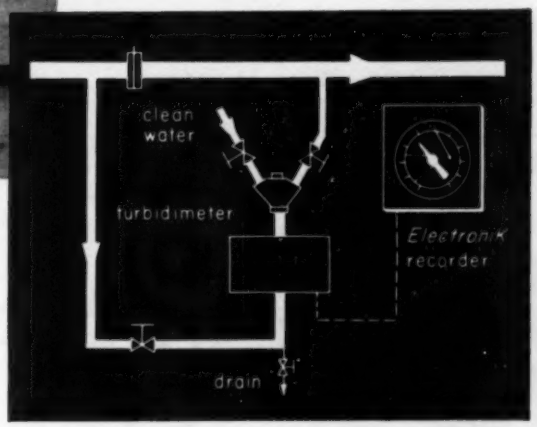
704

Pickett & Eckel, Inc., Chicago, Ill. has developed a new model device that combines the functions of T-square, triangles, straight-edge, scales and protractor, or drafting machine, in one simple unit without adjustments or additional parts. Paraline weighs less than 4 ounces and is easily carried in the pocket or brief case for use at home, class room or office. It may be used on any flat surface such as table or desk for ordinary drawings, or to speed up detail work on very large drawings where drafting machine or T-square are used on the drawing board.

(*Continued on page* 90A)



General Electric Recording ***Turbidimeter*** *includes sampling unit (at right) and* ***ElectroniK*** *recorder. Diagram shows how a typical installation is connected to sample from a main line.*



Here's the accurate, automatic way to measure turbidity

THE GENERAL ELECTRIC *Turbidimeter* fills a long-felt need for an automatic means of measuring the turbidity of liquids. Incorporating design features that assure consistent, reproducible results, this instrument eliminates the time, trouble and uncertainty of intermittent laboratory tests.

A specially designed sampling chamber and photocell circuit continuously measure the amount of suspended solids. To provide a continuous, permanent record of turbidity values, the system utilizes an *ElectroniK* recorder . . . which can be located at any distance from the *Turbidimeter*. The whole system is unaffected by fluctuations in line voltage or aging of the photocell . . . can be field calibrated for any range from 0-25 to 0-10,000 ppm. Over-all accuracy is ±5 per cent of full scale.

The *Turbidimeter* gives water, sewage and industrial waste treatment plants a precise method of continuously monitoring plant effluent . . . for evaluating surface water supplies . . . for adjusting feeding rates of coagulant and other filter aids . . . for scheduling backwashing, cleaning or diverting operations . . . and for evaluating the performance of treatment processes.

Contact the nearest General Electric office for further information. And for specialized assistance on treatment plant instrumentation, call your nearby Honeywell sales engineer . . . he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.

● **REFERENCE DATA: Write for Data Sheet No. 10.14-5a, "Continuous Turbidity Measurements."**

MINNEAPOLIS **Honeywell**

BROWN INSTRUMENTS

First in Controls

(*Continued from page* 88A)

Angles and tangents are accurately and rapidly projected by aligning the transparent protractor anywhere along the base line and rolling the instrument until the straight edge intersects the base line at the point at which the angle is to be drawn. Parallels are scaled rapidly without raising the device. It is extremely rapid in cross-hatching. The new Professional Model Paraline is 12½ in. x 3½ in. and is available with either Architect's or Engineer's scales. The Standard Model Paraline measures 10½ in. x 3-3/16 in., is available with Architect's scale only.

W. Smith

J. J. Carroll

Neptune Expands Sales Division

Neptune Meter Company, New York, N.Y., has announced Wentworth Smith, general sales manager, has been made vice president in charge of sales.

Mr. Smith's appointment is part of a reorganization of Neptune's sales division, according to D. E. Broggi, president. The sales reorganization, Mr. Broggi said, is the result of the recent acquisition of Revere Corporation of America, and its subsidiaries in Wallingford, Conn., and Cox and Stevens Aircraft Corporation in Mineola.

John J. Carroll, formerly district manager in Louisville, Ky., has been named to succeed Smith as general sales manager. Mr. Carroll, a native of Indianapolis, Ind., joined Neptune in 1939 as a sales representative in Indiana. Both he and Mr. Smith are members of the American Water Works Association.

Walter H. Sieger, formerly assistant to the general sales manager, has been named Sales Manager for petroleum and industrial meters used in the processing of chemicals, paper, candy, textiles, foods, beverages and other liquids.

20' diameter Hardinge Hydro Classifier with double screw dewaterer recovering fines from sand plant waste water.

Fines Separation and Control with HARDINGE HYDRO-CLASSIFIERS

The Hardinge Hydro-Classifier is a large-volume classifier for fine separating problems. It makes an efficient and economical unit, with positive control of the sizing and moisture of both oversize and fines. Separations from 48 mesh to finer than 400 mesh are possible. The coarse materials discharge at the bottom; the fines overflow the weir. May be supplied with screw dewaterer to discharge the underflow in a semi-dry condition. State your classification problem. Bulletin 39-B-15.

HARDINGE
COMPANY, INCORPORATED

YORK, PENNSYLVANIA • 240 Arch St. • Main Office and Works

New York • Toronto • Chicago • Hibbing • Houston • Salt Lake City • San Francisco

Make-Your-Own Neon-Effect Signs

705

Uni-Ventions Co., New York, N. Y., has developed Glo-Let letters that makes it possible to instantly convert standard fluorescent tubes into multi-colored neon-type signs with interchangeable letters and colors.

Glo-Let is a fraction of the cost of neon and its components are unbreakable. Its interchangeability in colors and letters gives it versatility and can be used on portable fluorescent tubes, or in any desired position. Glo-Let consists of individual letters, or numbers, that merely clip-on to the standard fluorescent tubes that illuminate as well as illustrate.

All dressed up and going places...

PITTCHLOR®

has an attractive new drum

This attractive red, white and blue drum is Pittchlor's new mark of distinction. Everywhere it is seen—in your buildings or around your premises—it is the sign of efficient, dependable chlorination.

Pittchlor is the ideal way to put chlorine to work at water works and sewage plants. It kills chlorine-susceptible bacteria and algae on contact. Pittchlor is excellent for chlorinating water supplies, treating sewage, and wherever the germicidal and deodorizing action of chlorine is needed.

Recognized by users everywhere as fast and effective, Pittchlor is a stable, high-test calcium hypochlorite containing a minimum of 70% available chlorine. It is granular, dry, white, non-caking, water-soluble, and easy to pour.

Pittchlor is now being shipped in these attractive 100 lb. drums. Place your order with your jobber now for quick delivery.

COLUMBIA-SOUTHERN CHEMICAL CORPORATION
SUBSIDIARY OF PITTSBURGH PLATE GLASS COMPANY
ONE GATEWAY CENTER · PITTSBURGH 22 · PENNSYLVANIA

DISTRICT OFFICES: Cincinnati • Charlotte
Chicago • Cleveland • Boston • New York
St. Louis • Minneapolis • New Orleans
Dallas • Houston • Pittsburgh • Philadelphia
San Francisco

Johns-Manville Expands Transite Pipe Service

Johns-Manville Corp., New York, N.Y., has announced that to expand service to Johns-Manville Transite, asbestos-cement, pipe customers, a new Marketing section has been established in the company's Transite pipe department.

Also announced were the appointments of Louis F. Frazza as Manager of the Direct Sales operations of the new section, assisted by Otto A. Wirsig, Staff Manager; and Edward C. Koch, Manager of Dealer Sales operations, assisted by James R. Allen, Jr., Staff Manager.

Mr. Frazza began his career with Johns-Manville in 1937 as a Transite pipe installation instructor for the New York District sales office. He was made a sales representative for the district Transite pipe department in 1939 and was appointed District Assistant Staff Manager in 1947. He was named a Staff Manager of the Transite pipe general headquarters in 1953.

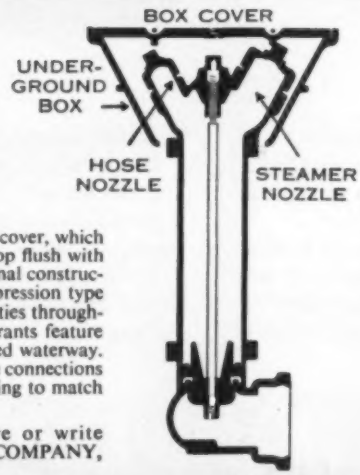
Reliance Chemicals Adds Wright to Staff

Reliance Chemicals Corporation, Houston, Texas has announced the expansion of its service to the municipal and industrial consumer by the addition of Mr. I. J. Wright, Jr., to its staff as an Industrial Waste Application Engineer. He was formerly Engineer in Charge of Waste Disposal at Crown Central Petroleum Corp., Houston refinery.

A graduate of Rice Institute, Mr. Wright will be available to industries to provide technical assistance in the application of Bionetic to various industrial waste problems.

This M & H Hydrant sets completely underground. The cast iron box cover is on line with the ground level, thus completely eliminating any interference with traffic. M & H flush type hydrants are especially designed for use at airports servicing the heaviest modern airplanes.

The operating nut and nozzles are accessible simply by lifting the two piece cover, which has disappearing handles designed to drop flush with the cover when not in use. Hydrant internal construction is exactly the same as M & H compression type fire hydrants used by so many municipalities throughout the country. M & H flush type hydrants feature a 5¼" valve opening and an unobstructed waterway. Can be supplied with one or two fire hose connections and/or with steamer nozzle, with threading to match existing standards.



For additional information, wire or write M & H VALVE AND FITTINGS COMPANY, ANNISTON, ALABAMA.

M&H PRODUCTS FOR WATER WORKS • FILTER PLANTS INDUSTRY • SEWAGE DISPOSAL AND FIRE PROTECTION

Vibrating Spatula

706

Fisher Scientific Company, Pittsburgh, Pa., has developed a spatula that has been combined with a midget vibration motor to speed up, and add accuracy to laboratory weighings.

With the Vibro-Spatula, particles can be dropped singly, or in a steady stream, or in rapid bursts, onto the weighing scoop or paper. The motor fits about as easily into the hand as an electric razor, and vibrates a stainless-steel spatula 60 times a second.

In use, the spatula is balanced on the fingers as easily as any spatula; scooped into the sample; held over the pan; and the power turned on with a finger-tap of the pushbutton switch. At the end of the dispensing, a few taps of the instantaneously-acting button will vibrate the last few crystals or grains into the pan.

American Water Softener Advances Egginson and Appoints New York Agents

American Water Softener Co., Inc., Philadelphia, Penna., has announced the appointment of Howard G. Egginson as Sales Engineer in the Philadelphia area. Mr. Egginson will also act as General Field Representative.

(*Continued on page* 94A)

~~MILLS PLASTIC~~ BUTYRATE III does jobs metal pipe can't do. Often cuts installation costs 50% and more

Mills Plastic III pipe weighs only about 1/10 as much as metal pipe of the same diameter, yet it takes on the toughest jobs. It speeds installations amazingly because it can be cut with an ordinary hand saw, and can be quickly joined with Milex fittings and Mills Plastic III Solvent. (The simple technique is shown at right. Flange adapter unions are available to adapt from S.W.P. sizing to iron pipe thread where required. Ask your distributor for details, or write for new booklet describing all Continental Mills Plastic piping, tubing and fittings.

PETROLEUM — Here's the ideal pipe for refinery discharge, crude oil, sour crude, salt water and natural gas.

UTILITIES — Easily installed in corroded gas lines by push- or pull-through methods. Eliminates trenching and repaving.

INDUSTRY — Successful where corrosive liquids or mineral depositions damage other pipe. Smooth walls increase flow rate.

AGRICULTURE — Installing stock watering lines, sprinkler systems and irrigation lines becomes a one-man job with Mills Plastic III.

1. Wipe pipe end with Mills Plastic III Solvent.

2. Wipe inside of fitting with Mills Plastic III Thinner.

3. Insert the pipe end into the prepared slip fitting.

4. The job's done. Pipe can be handled in minutes!

CONTINENTAL CAN COMPANY
MILLS PLASTIC PIPE DIVISION
SALES OFFICE
100 EAST 42nd STREET, NEW YORK 17, NEW YORK
Factory: 2930 North Ashland Avenue, Chicago 13, Ill.

● If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

(*Continued from page 92A*)

It was also announced that the American Water Softener Sales Co., 75 West Street, New York City, was appointed as exclusive representatives in the metropolitan New York and Northern New Jersey areas. Principals of the company are Edward Schumann and R. G. Sampson.

Ryerson Appointed Distributor of Carlon Plastic Pipe

Joseph T. Ryerson & Son, Inc., Chicago, Ill., steel service organization, is now distributing plastic pipe and fittings produced by the Carlon Products Corporation, Cleveland, Ohio. Service on these products is available through the sixteen Ryerson steel service plants located in major industrial areas across the country.

Both flexible and rigid Carlon plastic pipe are being sold by Ryerson, in a number of compositions, for use in all types of low pressure lines handling liquids, highly corrosive fluids, gases, vapors, and wastes. In addition to plastic pipe and fittings supplied from stock, service is available on custom produced plastic pipe for special applications. The Carlon line of plastic products supplements the Ryerson company's laminated industrial plastic supplied in sheets, tubes and rods which has been sold for many years under the trade name of Ryertex, principally in the form of bearings for steel mill, paper mill, and marine service.

To the four corners of the earth PEKRUL GATES are performing efficiently and dependably. PEKRUL Water Control Equipment is designed and developed to meet the most rigid requirements anywhere in the world.

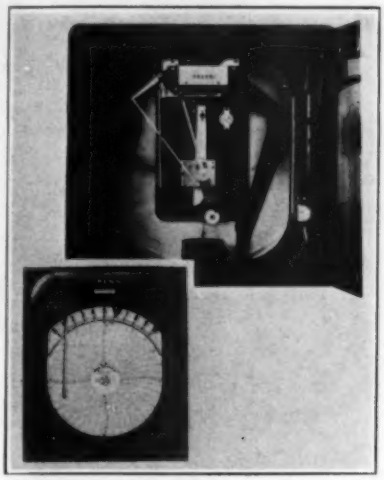
MANUFACTURERS OF PEKRUL GATES FOR

Flood Control	Sewage Disposal	Rearing Ponds
Levees	Reservoirs	Recreation Pools
Irrigation	Pumping Plants	Cooling Towers
Water Works	Oil Refineries	Steel Mills
Dams	Fish Hatcheries	

PEKRUL GATE DIVISION

Write for Catalog 49

MORSE BROS. MACHINERY
DENVER, COLORADO



Tilting U-Tube Mechanical Flow Meter

707

Penn Industrial Instrument Corp., Philadelphia, Penna., has given a "face-lifting" to the Tilting U-Tube Mechanical Flow Meter for adaptation to present-day instrumentation.

The basic operating principle of a U-tube balance has not been changed dynamically or dimensionally, so that it is still considered the most powerful mechanical meter available. It records flow on evenly graduated charts and may be equipped with a pneumatic transmitter. Utilization of torsion tubes have eliminated the necessity of springs, bellows, stuffing boxes or pressure-tight bearings. The new design incorporates a rugged simplicity and is virtually trouble-free, requiring little or no maintenance over long periods of time. Calibration can be accurately and quickly checked without disturbing the pipe connections, and the differential range may be altered at any time by merely changing the cam weight.

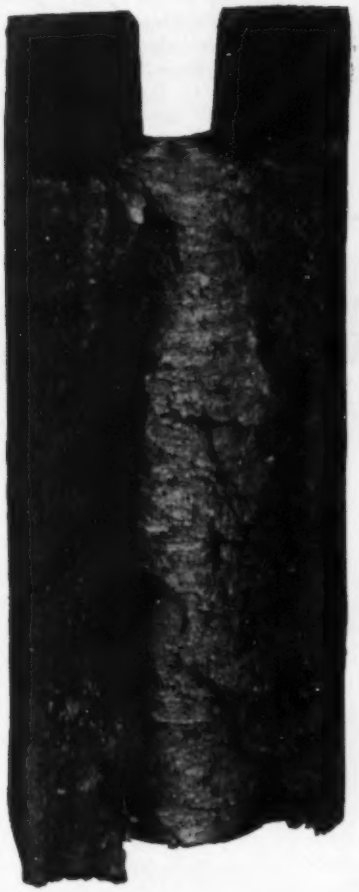
Changes in Sales Organization by Gould Pumps

Gould Pumps, Inc., Seneca Falls, N.Y., has announced the following changes in sales personnel:

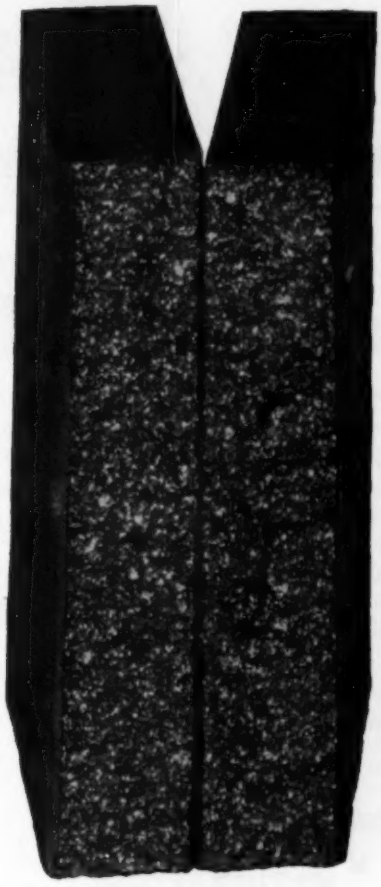
Mr. J. B. Darden, formerly in charge of Water System sales at the factory, becomes manager of Goulds' Chicago office. In that capacity he succeeds Mr. B. F. Barnett, who is

(*Continued on page 96A*)

HERE IS THE DIFFERENCE



WROUGHT IRON



STEEL

These are actual photographs of fractured pieces of wrought iron and steel. The picture at the left shows the fibrous structure of wrought iron. How this differs from the crystalline structure of steel is readily apparent. It is the presence of many thousands of tiny threads of glass-like iron silicate that gives wrought iron this unique fibrous structure and it is this structural feature, duplicated in no other metal, that gives wrought iron its superior resistance to corrosion and fatigue stresses.

While the initial cost may be higher, actual service records in numerous applications prove that wrought iron is the most economical buy because it lasts longer. Ask any Byers Field Service Engineer to show you fractured pieces, similar to those illustrated above. Write for our booklet, "The ABC's of Wrought Iron."

A. M. Byers Company, Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, San Francisco. Export Department: New York, N.Y.

BYERS

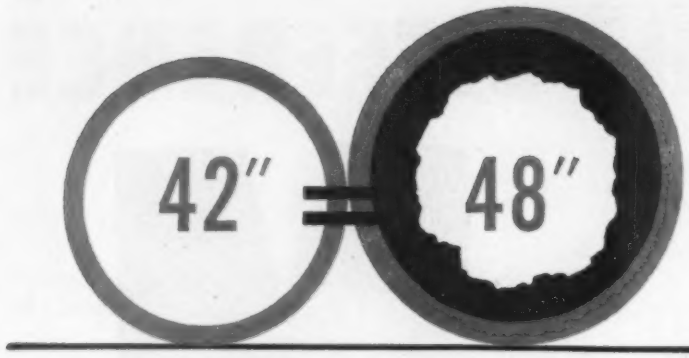
CORROSION COSTS YOU MORE THAN WROUGHT IRON

WROUGHT IRON

TUBULAR AND HOT ROLLED PRODUCTS

ELECTRIC FURNACE QUALITY STEEL PRODUCTS

● If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.



When 42″ is as big as 48″
you need... National

Yes, it's true!

Even a small amount of incrustation will reduce the carrying capacity of a 48″ main to that of a clean 42″ main.

The more your mains are clogged, the less capacity they have and the resulting reduced pressures increase pumping costs and fire hazard.

Take the easy way out—call National. Then, if your mains need cleaning we'll do the job quickly and effectively with little or no interruption in service.

Why not let our engineers find out what condition your water mains are in?

There's no obligation!

NATIONAL WATER MAIN CLEANING COMPANY
50 Church Street • New York, N.Y.

36

ATLANTA, GA; 333 Candler Building ● BERKELEY, CALIF; 905 Grayson Street ● DECATUR, GA; P.O. Box 385 ● BOSTON, MASS; 115 Peterboro Street ● CHICAGO; 122 So. Michigan Avenue ● ERIE, PA; 439 E. 6th Street ● FLANDREAU, S.D; 315 N. Crescent Street ● KANSAS CITY, MO; 406 Merchandise Mart and 2201 Grand Avenue ● LITTLE FALLS, N.J; Box 91 ● LOS ANGELES; 5075 Santa Fe Avenue ● MINNEAPOLIS, MINN; 200 Lumber Exchange Building ● RICHMOND, VA; 210 E. Franklin Street ● SALT LAKE CITY; 149-151 W. Second South Street ● SIGNAL MOUNTAIN, TENNESSEE; 204 Slayton Street ● MONTREAL, CANADA; 2032 Union Avenue ● WINNIPEG, CANADA; 576 Wall Street ● HAVANA, CUBA; Lawrence H. Daniels, P.O. Box 531 ● SAN JUAN, PUERTO RICO; Luis F. Caratini, Apartado 2184.

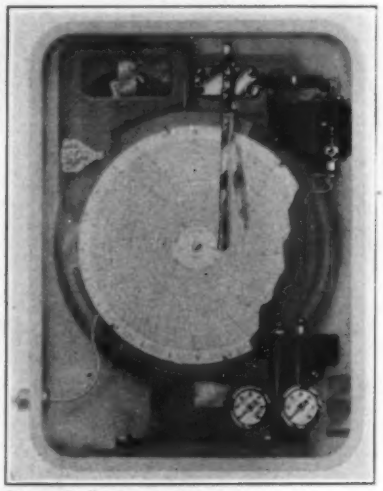
GATE OPERATORS
—
PORTABLE
—
FOR STANDS & UNDERGROUND GATES—MOTOR TRUCK MOUNTED
PAYNE DEAN & CO.
CLINTON, CONN.

(*Continued from page* 94A)

relinquishing his duties for reasons of health.

Mr. S. A. Bunis, formerly manager of the Boston branch, is transferred to the factory as assistant to Mr. Backlund, and will devote his time to sales operations of the Water System Division.

Mr. C. R. Brower, former manager of the company's Pittsburgh branch, takes charge of the Boston branch, and Mr. P. A. Thompson, formerly of the Chicago sales staff, becomes manager of the Pittsburgh branch.



Ring Balance Meter Signal Transmitter

708

Hagan Corporation, Pittsburgh, Pa., has announced that its Ring Balance Meter is now available with a specially designed pneumatic signal transmitter. This makes the instrument readily adaptable to a wide variety of remote metering and control applications, which include control installations requiring reset, remote adjustable set point and rate action.

The Transmitter is actuated by movement of the pen arm or indicator follower of the Hagan Ring Balance Meter, without introducing any perceptible load on the sensing element. These movements are transmitted to a baffle which moves about a fixed pivot to throttle air discharge from the control nozzle. Sensing element movement is, therefore, converted into a proportional pneumatic signal that faithfuly follows any function measured.

Available maximum signal pressure ranges are 15, 30 and 60 psi. This requires a continuous supply of compressed air. The changes from

(*Continued on page* 98A)

now...low cost quality water for smaller users

HIGH QUALITY WATER ★ LOW INSTALLATION COST ★ MINIMUM OPERATING ATTENTION

ACCELAPAK
(Trade-Mark)

water plant is the answer

"ACCELAPAK" equipment makes "custom plant" water quality available with "standard package" convenience and economy for . . .

- Small communities
- Camps and resorts
- Estates
- Industrial plants, etc.

"ACCELAPAK" Water Plant includes:

- ACCELATOR® clarifier or softener
- Slurry feeder for pulverized limestone or hydrated lime
- NEUSOL® feeder for coagulant (and hypochlorite when needed)
- Filter – gravity or pressure
- Other components as required

Capacities: 15 g.p.m. to 250 g.p.m. and up

▶ *for full details* on how the "ACCELAPAK" plant can provide you with high quality water, treated at a cost well within the budget, send this coupon now.

INFILCO

INFILCO INC.

Tucson, Arizona

Plants in Chicago and Joliet, Illinois

Field offices in 33 principal cities in the U. S., Canada and Mexico

INFILCO Inc., P.O. Box 5033, Tucson, Arizona

☐ Please send me Bulletin 1870E

☐ Please have an INFILCO representative contact me regarding "ACCELAPAK" treating equipment.

NAME_____

TITLE_____

COMPANY_____

ADDRESS_____

CITY_____ ZONE____ STATE_____

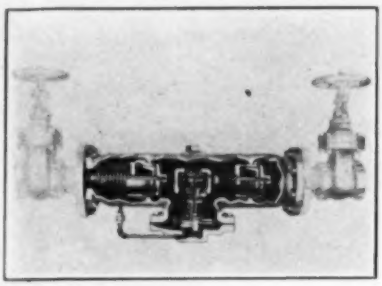
(Continued from page 96A)

one signal range to another requires only the substitution of the proper calibrating spring. The minimum signal pressure may be substantially zero, or may be suppressed to 3 or 5 psi. Output from the Transmitter can be used to actuate receiver type indicating, integrating or recording instruments, or as the actuating signal for an automatic control system.

Taft Joins Dravo Corp.

Dravo Corporation, Pittsburgh, Pa., has announced the appointment of Walter D. Taft, Jr., to its Philadelphia office staff as application engineer for Walker Process water treating equipment and De Laval pumps. Prior to joining Dravo, he was an instructor in sanitary engineering at Iowa State College, and a sales engineer for Process Engineers, Inc.

Mr. Taft obtained his enginering education at Virginia Polytechnic Institute, graduating with a BS in civil engineering in 1948 and receiving a master's degree in sanitary engineering in 1949. He now holds a professional engineer's license in the States of Pennsylvania and Virginia, and is a member of ASCE.



Backflow Preventers

709

Backflow Engineering & Equipment Company, Los Angeles, California, has announced that cross connections in water lines can now be protected by new, approved backflow preventers for all pipe sizes from 1 to 16 inches now being marketed after more than ten years of field testing and usage.

While these devices are used on all types of cross connections, they were primarily designed to protect between approved and unapproved water supplies frequently known as dual or secondary services and for industrializing lines within plants and consumers' premises. This backflow preventer, utilizing the "reduced pressure" principle, consists of two check valves and a monitoring relief valve system which automatically maintains a "zone" between the check valves in which the pressure is always lower than the inlet pressure and also provides visual indication if repairs are needed. It is due to these features that Beeco Backflow Preventers have received approval by the Research Foundation for Cross Connection control at the University of Southern California; The California State Board of Health; U.S. Public Health Service; U.S. Armed Forces and many others.

Hess Joins Pennsalt Representative's Staff

Universal Midwest, Inc., of Chicago, Ill., agents for the Pennsylvania Salt Manufacturing Company, has recently announced the addition to their staff of Mr. Walter F. Hess.

A mechanical engineer, Mr. Hess will handle sales of Pennsalt's line of chemical resistant cements, chemical resistant interliners, and chemical resistant coatings. With headquarters in Detroit, his territory will cover eastern Michigan, western Ohio and Kentucky.

Prior to coming with Universal Midwest, Mr. Hess was manager of die cast sales for C. M. Hall Lamp Company in Detroit.

no problem with water pressure in Newark!

Since 1934, by using cement lining in its trunk mains, Newark's water flow has been boosted from 57 to 83 million gallons a day.

This was made possible by converting old pipes into new—free of tuberculation and interior corrosion. Here's how it was done: old pipes were hydraulically cleaned, centrifugally machine-lined with mortar cement and smoothed to an even surface. The result: distribution pressure and carrying capacity greatly increased, maintenance costs substantially lowered and life expectancy of pipes extended indefinitely. Entire process done with pipes in place at a *fraction* of the cost of laying new pipes.

CENTRILINE CORPORATION

A subsidiary of Raymond Concrete Pile Co.

140 CEDAR STREET, NEW YORK 6, N. Y.

Branch offices in Principal Cities of United States and Latin America

3,000,000 FEET OF EXPERIENCE

Write today for booklet!

CEMENT-MORTAR LINING OF PIPES IN PLACE

In Lan… FASTER B…

TYLOX

…ing even gigan-
…of 84-inch. After
…fabricate… shown, merely
easing the pipe home to line and grade …hes the joint.
*Sealing by compression—not adhesion—T…X compen-
sates line angularities, is not affected by trend… ter, and
can be backfilled immediately.*

Lansing, Michigan"

MAKES SUBSTANTIAL SAVINGS IN CONSTRUCTION TIME AND COST BY COUPLING LARGE WATER LINE WITH Fast-working TYLOX Rubber JOINTS

The project was an intake water line for cooling light plant generators. Plans called for *big* pipe (84 inches in diameter); *tight,* non-deteriorating joints; and construction *within* the budget.

Tylox met all counts efficiently — plus giving a bonus in reduced construction time and cost. TYLOX is the *one* pipe joint that doesn't have to be "dug up" for repairs . . . that stays leak-proof *for the life of the line* . . . that enables construction men to lay pipe with cost-saving speed.

Write for illustrated data and more case histories on TYLOX. See *how* this joint promotes economical construction of sewerage, drainage and non-pressure water lines, *plus* assuring joints that will outlast the pipe itself. Read the facts, and specify TYLOX on *your* next pipe project.

✻ PROJECT: For the Board of Water and Light, Lansing, Michigan.

PIPE: Reinforced Concrete, furnished by Lamar Pipe and Tile Company, Saginaw, Michigan, a division of American-Marietta Company, Chicago, Ill.

ENGINEERS: Burns and Roe, Inc., New York, N. Y.
CONTRACTORS: Reniger Construction Company, Lansing, Michigan.

1912

HAMILTON KENT
MANUFACTURING COMPANY
427 West Grant St. Orchard 3-9555

● If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

Pipe Line Equipment
WATER • GAS • SEWER

Bottled Gas Lead Melting Furnace

Asbestos Joint Runners

Best quality asbestos rope, brass caps attached to each end. Equipped with clamps.

M-D Cut-In Connections for Sewers

A light cast iron fitting with bell end for connecting house service with main sewer pipe without necessity for placing a Y-branch or T-branch in the sewer line.

Leak Detector

A truly fine instrument designed to solve even the most difficult leak detecting problem.

Caulking Tool Outfit

For water mains up to 12". Strong leather bag. Keeps the right tool for every job within easy reach.

Test Plugs for Bell or Spigot End Cast Iron Pipe.

On this page are shown only a few of the hundreds of items to be found in the POLLARD Catalog. Write for a copy of Catalog No. 25G.

Portable Lead Melting Furnace

A handy outfit for quick action, equipped with gasoline burner.

Pipe Cutter

Inexpensive way of cutting pipe. Every wheel in contact with the pipe is a cutting disc, so cutter need be moved only a short distance to cut entirely around the pipe.

Tapax

The original manhole cushion. Takes the bang out of manhole covers.

M-Scope Pipe Finder

It's easy to locate a buried pipe line with this handy pipe finder.

JOSEPH G. POLLARD CO., INC.

Western Office
1064 Peoples Gas Bldg.
Chicago, Ill.

MAIN OFFICE AND FACTORY
New Hyde Park, N. Y.

Southern Office
333 Candler Bldg.
Atlanta, Ga.

HYDRO-TITE

DEPENDABLE JOINTING COMPOUND

Seals Bell and Spigot Water Mains

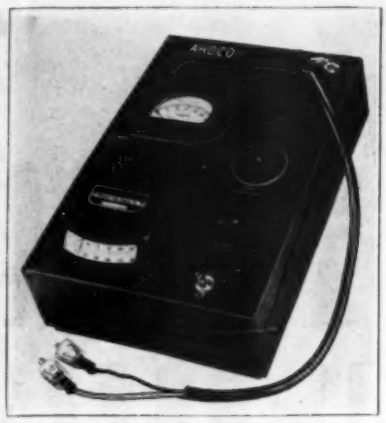
Economical—Effective

Over 35 Years Of Dependable Performance

HYDRAULIC DEVELOPMENT CORP.

MAIN SALES OFFICE **50 CHURCH ST., N. Y. C.**

General offices and works W. Medford Sta., Boston, Mass.

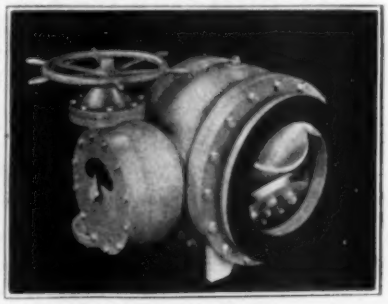


New Device Determines D O and O_2 Uptake Rates In Minutes

710

General Laboratory Supply Company, Paterson, New Jersey, has developed a device for the rapid, accurate determination of D O and O_2 uptake rates—in water and sewage chemistry—The ARDCO #535.

According to the company, analyses that have previously been tedious and time consuming, and therefore expensive, can be rapidly carried out employing this instrument. Simplicity and speed of operation are offered at no sacrifice in accuracy and sensitivity which may be obtained consistently with most chemical methods of analyses. Its usage eliminates chemical treatment and the necessity for color measurements. No special knowledge is required to operate it, just read the simple instructions. Completely self-contained (carrying its own power source) the Ardco #535 is compact and portable, making it ideal for field as well as laboratory work. Only 12" long by 8" wide and 5" deep, with no fragile dials or indicators, it is rugged enough for years of service.



S. Morgan Smith Offers New Line of Ball Valves

711

S. Morgan Smith Company, York, Penn., has announced a new line of

(*Continued on page* 102A)

LARGE BOULDERS NO PROBLEM FOR "Flexibles" AT SANDFORD, MAINE

From Sandford, Maine, to San Diego, California—from Seattle, Washington, to Miami, Florida, "Flexible" Equipment provides the answer to general and specific sewer-cleaning problems.

Sandford, Maine, for example, has been buying "Flexible" pipe-cleaning tools since 1936. Here one of the principal problems is bringing out large boulders that clog storm drains. And here is photographic "proof positive" that "Flexible" Bucket Machines get them out.

This photograph was taken some years ago. Since then "Flexible" Bucket Machines have been importantly modernized and improved in line with our constant study of sewer-cleaning needs and advanced engineering methods. We invite an "on the job" demonstration.

Write for our **FREE** *Catalog*

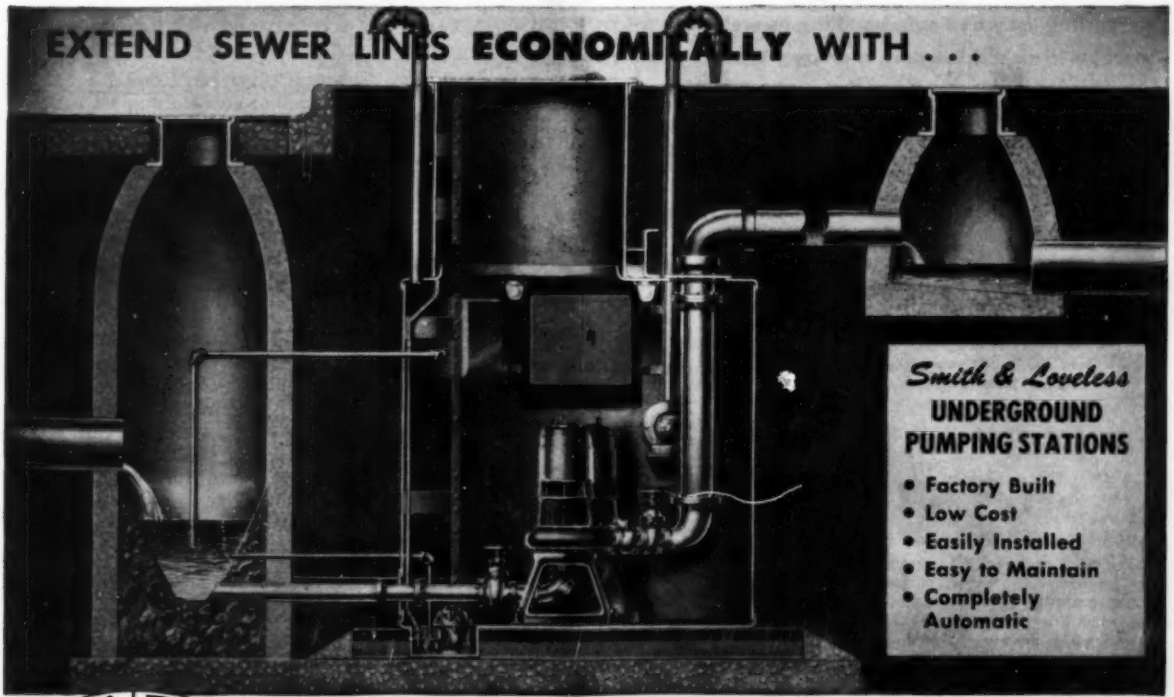
Flexible SALES CORPORATION

3786 Durango Ave., Los Angeles 34, Calif.

(DISTRIBUTORS IN PRINCIPAL CITIES)

AMERICA'S LARGEST LINE OF PIPE CLEANING TOOLS AND EQUIPMENT

EXTEND SEWER LINES ECONOMICALLY WITH . . .



Smith & Loveless
UNDERGROUND PUMPING STATIONS

- Factory Built
- Low Cost
- Easily Installed
- Easy to Maintain
- Completely Automatic

S&L *Smith & Loveless, Inc.*

Write for your free copy of our Engineering Data Manual, containing full details on Smith & Loveless Pumping stations.

P. O. BOX 8172, KANSAS CITY, MO., Plant, MERRIAM, KANSAS

● If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

Whatever your specific water treatment problem may be, you can figure on Ferri-Floc to do the job adequately and efficiently. A partially hydrated ferric sulphate, Ferri-Floc is a stable, free flowing, granular salt which can be fed with few modifications through any standard dry feed equipment. It is only mildly hygroscopic, thereby permitting easy and safe handling as well as storage in closed hoppers over long periods of time.

Water Treatment
Ferri-Floc coagulates surface or well waters, and it aids taste and odor control. It is effective in lime soda-ash softening, and is adaptable to treatment of practically all industrial water or wastes.

Sewage Treatment
Ferri-Floc coagulates waters and wastes over wide pH ranges. It provides efficient operation regardless of rapid variations of raw sewage, and is effective for conditioning sludge prior to vacuum filtration or drying on sand beds.

- **Rapid Floc Formation.**
- **PH correction.**
- **Taste and odor control.**
- **Color removal.**
- **Softening.**
- **Ease of operation.**
- **Bacterial removal.**
- **Manganese and Silical removal.**
- **Turbidity removal.**
- **Economy.**

SULPHUR-DIOXIDE HIGHEST QUALITY SO_2

SULPHUR-DIOXIDE is effectively used for dechlorination in water treatment and to remove objectionable odors remaining after purification.

COPPER TC SULPHATE

COPPER SULPHATE will control about 90% of the microorganisms normally encountered in water treatment plants more economically than any other chemical.

Free Literature! **Samples, Specifications and Detailed Information on Request.**

TENNESSEE TC CORPORATION

617-29 Grant Building, Atlanta, Georgia

(*Continued from page* 100A)

ball valves that rounds out a complete valve line offered by the Company.

The new Smith Ball Valves, manual type, are designed for 160 p.s.i. working pressures with 125 p.s.i., A.S.A. flanges (C.I.). The valve is comprised of three principal parts: the body, the rotor, and the operating mechanism. Ease of closure, tightness of closure, multiplication of leverage, and freedom from vibration are said to be the principal features of the new line. In addition to standard flanged ends, bell ends or plain ends can be furnished.

Rotary Airlock Feeder For Sewage Sludge

712

Prater Pulverizer Company, Chicago, Illinois, has announced a new Model PAV-12 Rotary Airlock Feeder. It has a 12 inch diameter inlet and discharge, and was developed especially for handling pulverized sewage sludge, phosphate rock, fly ash, etc.

Designed to prevent flushing of free flowing materials through stuffing glands and dust seals, the PAV-12 is ideally suited for removing such products from rotary dryers, coolers, dust collectors, electrical precipitators, bins, hoppers, and other process vessels, operating at atmospheric or higher pressures. Elevated temperatures can also be handled in this equipment.

Incorporating the new Prater closed pocket rotor, the 12" feeder performs a very important function in pneumatic conveying systems both as a feeder and an airlock to prevent air or gas leakage into or out of the system. It operates equally as well under pressure or suction and is easily adaptable to any ordinary pneumatic system in use today. It is available with or without packaged power.

On Main Street, or in the wild upper peninsula, you need the "Big 3"

There's a big copper refining plant on the shores of Lake Superior, near Ontonagon, Michigan.

They use a lot of water.

They wanted a *trouble-free* water line . . . one that would be as *nearly ageless* as man could devise . . . one with *great strength* to resist earth loadings . . . one with *sustained high capacity.*

These "Big 3" requirements were important to the White Pine Mining Company—so they specified Price Prestressed Pipe for a new 25,000 foot line of 36-inch pipe.

The same "Big 3" requirements were recognized by Miami, Louisville, Cleveland and many other cities large and small. Now they use Price Pipe.

You, too, need a pipe line that meets *all* 3 of the "Big 3"... *long life, great strength* and *sustained capacity.* Don't be satisfied with less.

Before you specify your new water supply line, call in our engineers. They'll show you how to get a trouble-free line of ageless concrete at the lowest possible cost.

Price Brothers Company

1824 East Monument Ave., Dayton 1, Ohio

Concrete Pressure Pipe for Water Supply, Subaqueous, Pressure Sewer and Culvert Installations

● If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

Remember:
the VALVES you buy today may have to be maintained by your GRANDCHILDREN!

Specify
IOWA because...

you can always count on Iowa for a lasting source of replacement parts . . . and products that service easily.

Look for These Features:

Double disc, parallel seat . . . positive wedging action for efficient, no-leak closing . . . gates hung loosely from stem nut—no binding . . . rugged, time-proved design means long life, low service costs . . . available with bell, flange, or mechanical joint connections to fit any existing or planned installation . . meet all A.W.W.A. specifications.

IOWA gate valves . . . for details, phone, wire or write:

IOWA
VALVE COMPANY
A subsidiary of James B. Clow & Sons
201-299 N. Talman Ave., Chicago 80, Ill.

Literature & Catalogs

Wedge Gate Valves

713

Kennedy Valve Mfg. Co., Elmira, N.Y., has announced the publication of a new condensed catalog covering **Iron-Body Wedge Gate Valves.** The new bulletin describes service applications and gives details of construction. It shows Outside-Screw-and-Yoke and Non-Rising Stem models and lists working pressures.

Revised Water Works Handbook

714

Rockwell Manufacturing Co., Pittsburgh, Pa., has announced a completely revised twelfth edition of its pocket-size **Water Works Handbook** with 28 added pages of water meter change gear charts and several other new features.

For the first time cutaway drawings of eight principal types of meters have been included in the handbook, and various other charts and tables of general interest to

(*Continued on page* 106A)

INCREASE SEWAGE PLANT CAPACITY WITHOUT CAPITAL COST!

WHAT IS IT?

- BIONETIC is a dry powder of preserved beneficial groups of micro-organisms that accelerate natural biological action.

WHAT DOES IT DO?

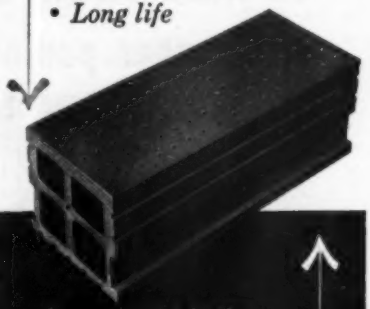
- BIONETIC can save money on sewage plant problems including odor control, increased sludge digestion capacity, and scum blanket control.

INTERNATIONAL ACCEPTANCE:

- BIONETIC is successfully used by hundreds of municipalities, industries, resorts, and institutions.

For FREE Literature Write:
A. J. Krell, technical director
Reliance Chemicals CORPORATION
P. O. BOX 6724 HOUSTON 5, TEXAS

- *Permanence*
- *No tuberculation*
- *Equal distribution*
- *Uniform filtration*
- *Low loss of head*
- *Acid, alkali-resistant*
- *Long life*



You get ALL these advantages with
LEOPOLD
Glazed Fire Clay
TILE FILTER BOTTOMS

Today, in more than 250 plants with a daily capacity of over 1¼ billion gallons, Leopold Duplex Filter Bottoms are providing dependable, economical service with minimum maintenance.

Made of highest quality de-aired fire clay—vitrified and salt glazed, the Leopold Filter Bottom requires only a shallow depth of small sized, inexpensive filter gravel to support the filtering medium. Further, the laterals and distributing blocks are all combined in one strong permanent unit that will last indefinitely.

Adaptable to any rectangular filter unit, the Leopold Glazed Tile Filter Bottom is designed to successfully meet all underdrain requirements.

Each Leopold filter block is about 2 sq. ft. in area—weighs approximately 100 pounds.

Complete Water Purification and Sewage Plant Equipment . . .

- DRY CHEMICAL FEEDERS
- FILTER OPERATING TABLES
- MIXING EQUIPMENT

Want more details? Write us today.

F. B. Leopold Co., Inc.
2413 W. Carson Street
Pittsburgh 4, Pa.

Sure, that old pump still works,

but how much does it cost to keep?

That rugged old pump of yours may not be the bargain that it seems. Let's do some arithmetic. If the efficiency of the old pump is 75% vs. the 85% efficiency of the new pump, you are paying more to keep it than you would to replace it. That's because a new unit of equivalent output uses less power. Thus it soon saves its own cost — then begins to pay dividends.

Let's take a specific example—a water works pump

Old pump efficiency 84%	625 BHP
New pump efficiency 89%	590 BHP
	35 BHP Saving

On the basis of 1¢ per KWH, the 35 BHP saving for a 5000-hour year (approximately 14 hours per day) amounts to $1300. This saving, capitalized in 15 years at 5% adds up to $28,000. Yet the price of the new pump that saves $28,000 is only $4054.

What would the pump replacement profit be in your particular case? Your De Laval representative can tell you exactly — in dollars and cents — as soon as he has the basic facts on your present installation. Call him in today or write to De Laval for Pump Fax Bulletin which includes a valuable "power-savings" chart.

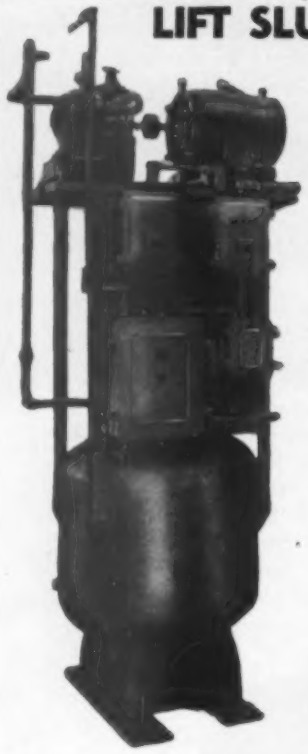
DE LAVAL *Pumps*

DE LAVAL STEAM TURBINE COMPANY
824 Nottingham Way, Trenton 2, New Jersey

DL237B

● If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

LIFT SLUDGE AND SEWAGE



Compact ejector system having motor compressor assembly and all controls in one "packaged" unit.

..Unfailingly..With Rugged, Dependable

BLACKBURN-SMITH PNEUMATIC SEWAGE EJECTORS

Obviate complex piping for air and water. Eliminate clogging of screens, impellers, and shredders.

30 to 500 GPM in both single and twin units against high discharge heads.

Exclusive Modern Features

Over 50 years service has proved the worth of Blackburn-Smith Ejectors. Yet our today's product is full of exclusive modern features such as:

1. Float and electrical float switch controls.
2. Float and pneumatically controlled snap action valve.
3. Electrode controls.

Any one of the above, with or without Air Receivers. Get Catalog S50.

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(*Continued from page* 104A)

water works men have been brought up to date.

In addition to specifications tables for all Rockwell meters, the book includes such general information as standard specifications for cast iron and standard wrought iron pipe, table of equation of pipes, water meter testing hints and tables, instructions for reading water meters, water use rate tables, flow charts, hose and fire stream data.

It also includes more basic information such as the properties of water, weights and measures, and conversion tables.

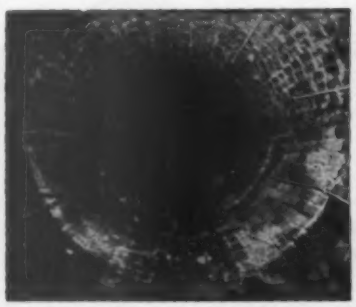
pH Control in Industry

715

Beckman Instruments, South Pasadena, Calif., has published an informative report on the Role of **Automatic pH Control in Industry**—to help executives, process engineers and chemists better understand this important technique.

The 12-page brochure gives a picture of continuous pH recording and control in three major processing areas—water treatment, control of chemical reactions, and waste disposal. Simplified diagrams and

(*Continued on page* 108A)



"GUNITE" STRENGTHENS EXISTING SEWERS

Reinforced "GUNITE" lining has been successfully used on brick, tile and concrete sewers, restoring them to greater than originally designed strength.

Erosion of mortar joints and dislodged bricks made many sections of the above 65-year-old brick sewer in Illinois both dangerous and inefficient. We placed a reinforced "GUNITE" lining of varying thickness in this sewer without opening the streets. Sewer service was maintained by installing temporary flumes and also by by-passing through relief sewers.

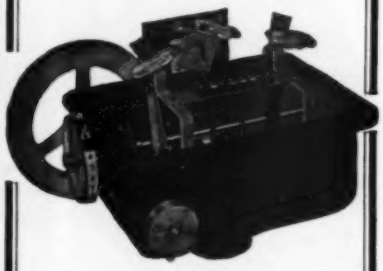
This job, and many other types of "GUNITE" jobs which we have done, are illustrated and described in our new 64-page general bulletin C2400. A request on your letterhead will bring you a free copy by return mail.

We will be pleased to cooperate with you on any of your problems.

CEMENT GUN COMPANY
"GUNITE" CONTRACTORS
GENERAL OFFICES – ALLENTOWN, PA., U. S. A.

MANUFACTURERS OF THE CEMENT GUN

ROTO-TROL



RF-2

WITH ALTO-TROL

This 2-pump RF-2 Roto-Trol assures equal use and wear of both pumps. Each pump is operated on alternate starting cycles. The RF-2 operates both pumps together, when required. RF-2 installations give dependable service year after year, with the minimum of attention.

Write for full data

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"I'll admit I was pretty skeptical when the Buffalo Meter Co. representative wanted to take an American Meter apart on my desk.

But he disassembled it, put it together and then let me do it. It took only a minute!

I'd never seen a water meter so simple, with so few parts, such easy assembly.

"We placed our first order after I found out that parts are completely interchangeable on brand-new meters or ones thirty years old. When I think of the savings we'll make in repairs alone, I'm sorry we didn't install AMERICAN METERS years ago."

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2909 Main Street, Buffalo 14, N. Y.

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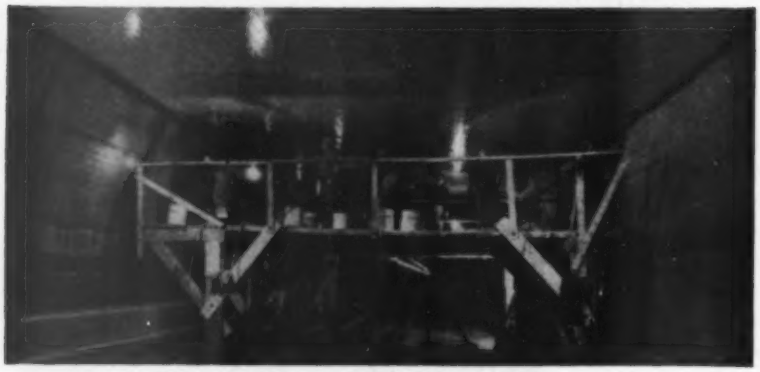
Underneath the river!

THORITE Patching Mortar Crew at work in Air Tunnel under East River, New York.

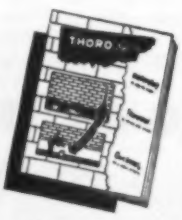
Sealing Leaks in Traffic Tunnel with WATERPLUG.

Sealing Drain Pipe Channels in Tunnel with WATERPLUG.



WATERPLUG Crew at work, before placing of tile lining, Battery Tunnels, East River, New York.

On many of the largest underground projects in the Americas and in foreign countries, WATERPLUG solves, for the contractor, his water problems. The job may be small or it may be large, the results are the same — Successful.



Get our 20-page brochure, pictorially describing, in detail, "How To Do It." It's yours for the asking. — No. 140.

Standard Dry Wall Products

BOX X, NEW EAGLE, PENNSYLVANIA

(*Continued from page* 106A)

sketches describe typical pH installations for a variety of processes, with emphasis on improved product quality, better process efficiency and lower material and maintenance costs.

A separate section on chemical reactions explains pH control in emulsification, electrolysis, neutralization, hydrolysis, biochemical processing, coagulation and precipitation, and bleaching, dyeing and conditioning of fibres and fabrics.

Equipment for Industry

716

Worthington Corp., Harrison, N. J., has published a bulletin on **Equipment for Industry.**

The bulletin contains information about special features, types, sizes and capacities of Worthington's various product lines of industrial equipment, and describes the application of each of these lines in various industries.

A number of illustrations show, as representative samples, how Worthington products apply in different types of industry.

Trencher Bulletin

717

The Cleveland Trencher Company, Cleveland, Ohio, has just issued a new 8-page, 2-color bulletin on the **Cleveland Model 140 Trencher.** According to the bulletin the Model 140 has been an outstanding performer for over 15 years on pipelines, water lines, drainage, irrigation, sewer lines and utilities—on all jobs from 18 to 30 inches wide and up to 5½ feet deep.

Special features of the Model 140's design and construction are fully described in the bulletin. Recent action photos illustrate the various job applications within the scope of the 140. The bulletin contains complete dimensions and specifications including a table of digging wheel and crawler speed combinations available in Cleveland's famous multi-speed transmission and a table of standard and maximum cutting widths.

Pulsafeeder for Controlled Volume Pumping

718

Lapp Insulator Co., Inc., Process Equipment Div., LeRoy, N.Y., has just published a 24-page, 2-color bulletin describing the **Lapp Pulsafeeder** diaphragm-type controlled volume pumps.

The maintenance free feature of no stuffing box is stressed throughout the bulletin, and it is also pointed out that Pulsafeeder, although basically a pump, also functions as a chemical feeder, a meter, an instrument, a filling machine, a proportioner and a sampler.

The bulletin also covers in considerable detail special liquid handling assemblies which include a completely non-metallic construction of Lapp chemical porcelain and fluoro-plastics, a double diaphragm head for liquid chlorine and other hazardous liquids, a completely isolated remote pumping head, a head for gas compression and transfer and an all welded assembly without gaskets.

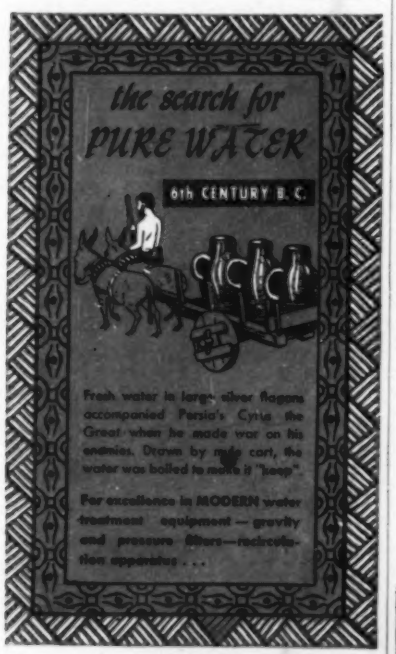
Concrete Pressure Sewer Pipe

719

Price Brothers Company, Dayton, Ohio, has just published a 4-page, 2-color folder on **Price Pressure Sewer Pipe.**

The folder discusses how concrete pressure pipe meets the requirements for sewer force mains, sewer lines free from infiltration, or subaqueous sewer lines, with high structural

(*Continued on page* 110A)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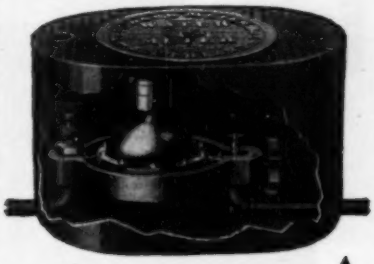
Left, No. 16 Clark Wonder Lock Meter Box Round....16" and 18" diameters. Large 13" lid.



Above, No. 11 Oval Clark Wonder Lock Meter Box, especially for warmer climates. H-11", L-18", W-12".

Below, A-2-13 Clark Meter Box Cover with screw lock. Height 4", lid opening 13".

Above, A-2-11 Clark Single Lid Meter Box Cover, 4" throat. Also available in 6" and 9" throat.

Below, B-2-11-L Clark Double Lid Meter Box Cover, 6" throat. Also available in 4" and 9" throat.

Above, AA-3-12 Clark Meter Box Cover with 13" Wonder Lock Lid, for use with 15" (illustrated), 18" and 20" box body.

Improved Screw Lock with strong forged bronze bolt.

Wonder Lock Lid (bottom view) showing forged bronze bars.

Perfect Lock of one-piece manganese bronze forging.

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MATTOON, ILLINOIS

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3. Presstite KALKTITE... cold mixed and applied joint sealing compound that sets up even under the most adverse conditions and forms a dense, tough and flexible seal that *stays* watertight.

For substantial savings in time and labor, too, you can't beat the Presstite System. Its fast, easy application allows installation of more joints per man, per hour, per day.

PRESSTITE Sealing Compounds

WRITE TODAY for samples and complete details on Presstite's cold applied 3-Step System for tighter, better sewer joints.

PRESSTITE ENGINEERING COMPANY

3780 Chouteau Ave. **St. Louis 10, Missouri**

(*Continued from page* 109A)

strength, bottle-tight joints and other advantages.

A catalog page lists sizes available of Concrete Pressure Sewer Pipe, Non-Pressure Concrete Sewer Pipe (with rubber gasket) and Regular Concrete Sewer Pipe.

Ring-Tite Joints on Valves and Hydrants

720

Rensselaer Valve Co., Troy, N.Y., has just released a bulletin on the Ring-Tite Joint on **Rensselaer Valves and Hydrants.**

The 4-page, 2-color bulletin gives complete description and installation instructions for both the valves and hydrants. Sectional drawings and installation photographs are also included.

Rock and Earth Trench Drill

721

The Salem Tool Company, Salem, Ohio, has available a 2-page, 2-color bulletin on the **McCarthy Rock and Earth Boring Trench Machine.**

The bulletin describes how the Trench Drill is equipped to handle augers from 4 to 16 inches in diameter and will drill holes from 10 to 150 feet horizontally. Photographs of the machine and application drawings are also included.

Three New V-Belt Slidefilms

722

Allis-Chalmers Manufacturing Co., Milwaukee, Wis., has announced the second group in a series of educational 35mm sound slidefilms for industry.

The three slidefilms are on the subject of v-belt drives and each run about 20 minutes. They are titled **"In Every V-Belt Drive," "For Better Driving,"** and **"Selecting a Drive."**

The first, in color, covers the engineering principles that are basic in every v-belt drive application. The second concerns itself with the

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installation and maintenance of multiple v-belt drives. The third tells how to check characteristics to find the best type of drive and then engineer it to do the job.

Prepared for such audiences as industrial maintenance men, plant engineers, design engineers, and engineering students, the films make good use of drawings, humor and step-by-step photographs to get their points across.

Requests for showings of any of these slidefilms should be made to the nearest Allis-Chalmers General Machinery Division district office.

Guide for Figuring V-Belt Drives

723

Allis-Chalmers Manufacturing Co., Milwaukee, Wis., has just published a six-page interim bulletin which provides in condensed form the necessary information on the new method of calculating the horsepower capacity of a **"Texrope" V-belt drive.**

The belt ratings resulting from this new method take into consideration effect of belt length, ratio of the diameters of both the driving and driven sheaves upon the horsepower rating of the belt, and resultant belt life. These are features which were not adequately reflcted in the former V-belt horsepower ratings.

The new formula provides means of determining the ratings for both standard construction and high capacity "Texrope" V-belts.

All sheave and V-belt manufacturers in the industry have approved and accepted the belt horsepower ratings derived from this new formula.

Seal-Less Rotary Distributor

724

Smith & Loveless, Inc., Kansas City, Mo., has available a 4-page bulletin on the **Sy-No-Seal Rotary Distributor.**

The bulletin describes the Sy-No-Seal as a distributor without a seal that starts faster, runs faster, gives more uniform distribution, and requires less maintenance and service. A text-keyed drawing gives complete operating details. Typical specifications and a list of features complete the bulletin.

1. Large illustration shows Singl-use Fiberform ready to be filled.
2. Filling plate and collar simplify pouring concrete into form.
3. Completed meter box barrel.
4. Meter box with cover in place.

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FORD *Singl-use Fiberforms*

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